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THE

JOURNAL OF SCIENCE.

SEPTEMBER, 1881.

I. THE CENTRE OF GRAVITY OF THE EARTH, AND ITS EFFECT ON ASTRONOMICAL OBSERVATIONS.

By Col. A. W. Drayson, R.A., F.R.A.S.

(Concluded from page 448.)

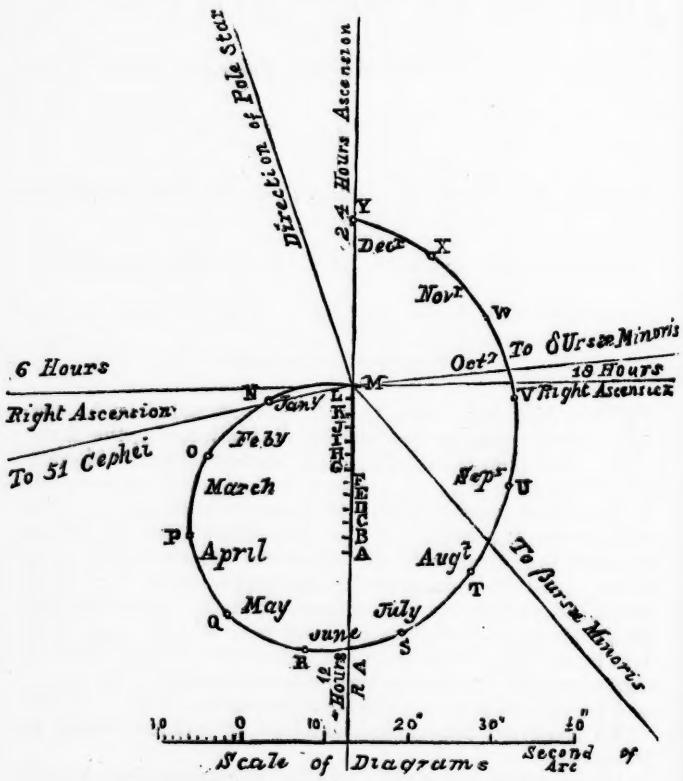
THE Nautilus curve traced by each pole can be constructed from the data already known, viz., the North Pole changes its direction, due to the change in direction of the Earth's axis, about 20″·25 annually towards the first point of Aries. Whilst the North Pole is tracing this line, or arc, the zenith of the pole—found by a plumb-line directed to the centre of gravity of the Earth—will trace a circle round the movable pole; consequently, as the zenith of an observer at the pole is supposed to be the same point in the Heavens as that occupied by the pole, the appearance will be as though the pole itself actually traced the Nautilus curve, and the effects on stars declinations and right ascensions will be the same as though the poles traced this curve.

To construct the curve the following method should be adopted:—

Draw a line (A M, Diagram 3) of any convenient length, say 2 inches, and construct a scale of seconds of arc, so that A M on this scale is 20″·25 in length; the line A M represents the course of the North Pole towards the first point of Aries during any year. Divide the arc A M into twelve equal parts, to indicate the position of the North Pole on the 1st day of each month. Consequently A is the position of the North

Pole of the Heavens on January 1st, B its position on February 1st, C on March 1st, and so on. With a radius of 20″·7, a circle described round the movable points A, B, C, &c. will give the Nautilus curve, allowing $\frac{360^\circ}{12}$ for the arc

DIAGRAM 3.



Apparent Curve traced by the Zenith of the North Pole annually, due to the position of the Centre of Gravity of the Earth.

for each month. Thus an arc of 30°, viz. N A M, will give M N, the course of the zenith at the North Pole during January.

With B as centre, and same radius, describe an arc of 30°, viz. N B O; N O will be the arc described by the zenith at the pole during February.

With C as centre, and same radius, describe an arc of 30°, viz. O C P; O P will be the apparent course of the zenith at the pole during March.

Proceed in the same manner, and the Nautilus curve is completed by the arc X Y, which is the arc described by the zenith at the pole during December.

The month indicated is written against each portion of the curve.

As the arc A M is towards 0 hours right ascension, 12 hours right ascension will be in the opposite direction, viz., in the direction M A; whilst 6 and 18 hours right ascension will be indicated by two lines drawn at right angles to A M and through M, 6 hours being on the left, 18 on the right. The scale at foot of diagram shows seconds of arc. The value of this curve can now be demonstrated, and its accuracy or inaccuracy tested by any reader acquainted with the mere elements of astronomy, for he will by aid of this curve be able to measure off the scale the actual changes in seconds in the declination of stars near the pole for each month in the year; also the changes in right ascension of all stars in the Northern Hemisphere. Any stars near the pole may have their direction plotted on the diagram, and their changes in right ascension and declination can be shown by this diagram.

Four stars near the North Pole will be selected, viz. the Pole Star, 51 Cephei (HEV), δ Ursæ Minoris, and β Ursæ Minoris, the direction of which stars is shown on the diagram; but it must be remembered that the distance of these stars from the pole is so great, when compared with the breadth of the curve shown on diagram, that the arcs from the pole to the star are *nearly* parallel to one another, no matter where the pole may be situated on this curve.

The effects on the polar distance of the Pole Star will first be examined, and the direction of this star is plotted on the diagram.

During the month of January the pole moves from M to N, or nearly at right angles to the arc joining the pole and the Pole Star. Consequently, on February 1st and January 1st, the polar distance of the Pole Star ought to be nearly the same. The observations of many years show that the polar distance of the Pole Star at these dates varies only 1-10th of a second. The curve, however, between M and N does bend slightly towards the Pole Star. So, if observation be correct,

the polar distance during the middle of January ought to be slightly less than on the 1st and 31st of January. Recorded observation gives 1″ for this decrease.

During February the pole moves from N to O, consequently obliquely away from the Pole Star. Draw a line from N away from the Pole Star, and from O draw a line at right angles to the line joining O and the Pole Star, and where this line intersects the line from N we obtain a point the distance of which from N will give the change in polar distance of the Pole Star during February. This measured distance is about 4″·3. Recorded observation gives 4″·3. During April the pole moves from P to Q; that is almost directly away from the Pole Star. Measure the arc P Q, and this arc by scale will give slightly more than 10″ as the amount by which the polar distance of the Pole Star increases during April. On referring to the "Nautical Almanac" it will be seen that between March 31st and April 30th the polar distance of the Pole Star increases 9″·1.

Following the curve we find that between R and S—that is, about the middle of June—the pole is moving at right angles to the arc then joining the pole and the Pole Star, at which date the pole cannot vary its distance from the Pole Star. On examining the "Nautical Almanac" (1880) it will be seen that on the 18th of June the pole does not vary its distance from the Pole Star. We may now test the amount of change in polar distance of the Pole Star between June 18th and the end of January, when a line from that part of the curve indicated by 18th June to the Pole Star cuts the arc N M near N. The length of this arc from scale gives 31″, which is the increase in polar distance of the Pole Star between January 29th and June 18th. Observation, as recorded in the "Nautical Almanac," gives 31″ for this change. As the curve traced by the pole moves round to S, T, U, &c., the pole decreases its distance from the Pole Star, and from V to W during October moves directly towards the Pole Star. The arc now traced each month is a longer arc than is the arc traced during the early months of the year. Consequently when we measure the arc V W from scale we find it slightly more than 11′, by which amount the polar distance of the Pole Star must decrease during October. The recorded observations in the "Nautical Almanac" give 11″·3 for the decrease during October.

We now refer to the monthly changes in right ascension as regards the Pole Star. When the pole is carried by the annual rotation from M to N the same effect on the right ascension is produced as though the star moved over a

similar arc in the opposite direction. Consequently during January the right ascension of the Pole Star will decrease rapidly. During the course of the pole from P to Q, during April, the right ascension will be *nearly* constant, and about April 1st—when a line from the star to the pole is tangential to the curve then traced by the pole—the right ascension at that date will not vary. Observation, as recorded in the "Nautical Almanac," agrees with minute accuracy with the above details.

Again, about June 18th the right ascension of the Pole Star will increase rapidly, whilst about the end of October —when the arc from the Pole Star to the pole is tangential to the curve—the right ascension will be again a constant. Observation proves this to be the case. The change in polar distance of the Pole Star between June and December can also be taken off scale, and the value found to correspond with observation.

We can now test the accuracy of this curve by another important star, viz., δ Ursæ Minoris. The direction of this star is also plotted on the diagram, its right ascension being about 18 h. 10 m. During January the pole moving from M to N moves directly away from δ Ursæ Minoris. Consequently the polar distance of this star will increase during January by the length of the arc M N: the length of this arc by scale taken off the diagram will be found about 9″·5, and the recorded increase in polar distance of this star—found after years of observation, and recorded in the "Nautical Almanac"—is 9″·2 for the month of January.

By examining the curve on diagram, the following questions can be answered:—

1. When will the polar distance of this star remain constant during a few days?—When the pole is near the point P, at which time the pole is tracing an arc at right angles to the arc then joining the pole and the star.
2. When will the polar distance of this star decrease most rapidly?—When the pole is moving from R to S; that is, during June, at which date the polar distance will decrease by the amount of the arc R S.

Examine the recorded observations in the "Nautical Almanac," and these two facts agree with the results of observation.

3. When will the polar distance of this star remain a constant during the latter portion of the year?—When the pole is at V on October 1st, at which date the pole is moving at right angles to the arc then joining the pole and the star.

4. What will be the greatest variation during the year between the polar distances of this star?—The greatest length of the arc, within the curve, of a line drawn parallel to the direction of the star: this arc it will be found is about 40″.

Again corresponding with recorded observations. The same test may be applied to the star 51 Cephei, or any other star near the pole, and the Nautilus curve will give the same exact results.

Consequently we have a curve which gives accurately by scale the changes which take place in the polar distance of any star near the North Pole during each month of the year. The same curve shows where the right ascension of *any* star in the Northern Hemisphere will change most during the year, and where it will be a constant. In all cases the right ascension of a star will be a constant when a line from the star to the curve is tangential to the curve, and the variation in the right ascension will be greatest when a line from the star to the curve cuts the curve at right angles.

The Nautilus curve which gives these exact results is the curve which would be traced at the pole by the zenith during a year, when observations were taken at the instants of time indicated by midnight at Greenwich, for each day of the year, and *due to no other cause than the fact that the centre of gravity of the Earth is not coincident with the Earth's centre.* This curve is at present unknown to astronomers or geometricians.

Having demonstrated the curve which applies to north stars, I next give the Nautilus curve for the South Pole. If the curve for the South Pole reveals equal accuracy, although a different curve, it seems difficult to find any more complete proof of the truth of the facts here advanced.

The Curve traced by the South Pole annually (Diagram 4).

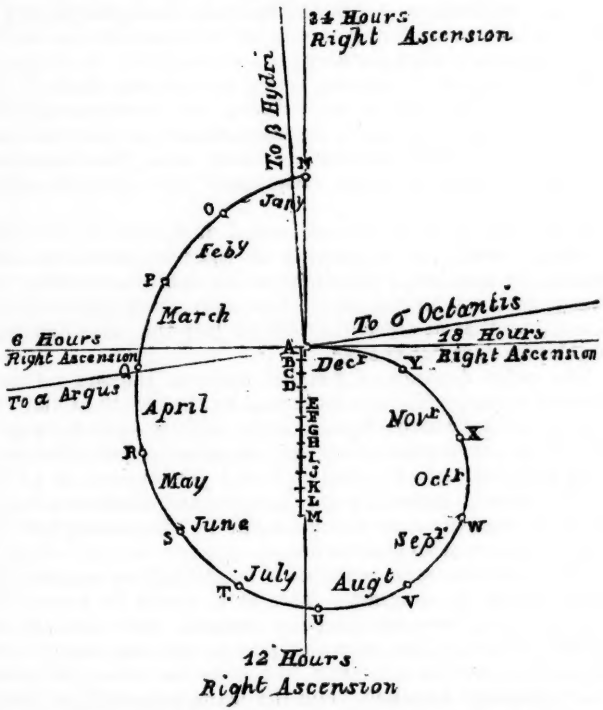
The annual rotation of the Earth causes the South Pole of the Heavens to trace a curve slightly different in form from that traced by the North Pole. The centre of the circle traced by the South Pole moves 20″·25 annually towards 12 hours right ascension, whereas the centre of the circle traced by the North Pole moves 20″·25 in the opposite direction,—that is, towards 24 hours right ascension.

The curve traced annually by the South Pole is constructed as follows:—

Draw the line A M 20″·25 in length; divide the line into 12 equal parts. This line represents the course towards

12 hours right ascension of the South Pole of annual rotation. The point A will be the position of this pole on January 1st; B its position on February 1st; and so on. If the annual rotation did not occur the pole N would, during the year, move down the arc N A. But the pole N rotates

DIAGRAM 4.



Apparent Curve traced by the Zenith of the South Pole annually, due to the position of the Centre of Gravity of the Earth.

round the moving centre, A, B, C, &c.; so that the pole N moves to O during January, to P during February, to Q during March, and so on, reaching the point near A on December 31st. The accuracy of this curve can now be tested by the aid of southern stars near the South Pole of the Heavens.

The first star we find in the "Nautical Almanac" having

south declination, and near the South Pole, is β Hydri, with a right ascension of about 19 m. = 4° 45′ in arc. The direction of this star is plotted on the diagram.

During January the South Pole, moving from N to O, increases its polar distance from β Hydri by the amount of the arc obtained by drawing from O a line at right angles to the line drawn from β Hydri through N, and measuring from N to the intersection. This arc by scale is slightly over 5″. Recorded observation gives 5″·2 for the increase in south polar distance during January.

When the pole is moving from Q to R, during April, it is moving directly away from β Hydri, and consequently increases its polar distance by the amount of the arc Q R. This arc measured off scale is about 11″. The recorded change in the "Nautical Almanac" for April is also about 11″.

When the pole is moving round that part of its arc between T and U, it is moving at right angles to the line joining the pole and β Hydri, at which date there will be no change in the polar distance of this star. Recorded observation shows that at about the 20th of July the polar distance of β Hydri does not change.

The polar distance of β Hydri between January 1st and the end of July will have increased by the length of the arc U N, which measured off scale gives slightly more than 51″. Recorded observation gives the increase in polar distance from this star, between July 20th and January 1st, as 51″·2.

The other changes in polar distance, and also the changes in right ascension, as demonstrated by this curve, will be found to agree with observation.

The southern star σ Octantis is plotted, as regards its direction, on the diagram. This star, it will be seen from the diagram, increases its polar distance until the end of March, when the line from the star to the pole at Q is at right angles to the arc then traced by the pole. Examine the "Nautical Almanac," and the same facts will be found recorded, as having been found by observation in the Southern Hemisphere.

When the pole is at W, on October 1st, the pole is moving at right angles to the arc joining the pole and the star; consequently the polar distance of the star at that date will not vary. It is recorded, in the "Nautical Almanac," that the polar distance of this star does not vary at that date.

From these results, and those derived from every other star near the poles, it is found that the two curves given above are the correct curves apparently traced by the poles

annually, and we can obtain from these curves even more accurate results than can be obtained by years of wearying observation at hundreds of observatories.

That which makes the problem at first sight somewhat complicated is, that whilst this annual rotation displaces the poles of diurnal rotation, the same annual rotation will not displace the plane of the Equator; consequently the plane of the Equinoctial would still cut the Heavens in the same great circle, no matter whether one rotation occurred round the poles of the Heavens or round two other poles distant 20″ from them, and on the same meridian of right ascension.

That the centre of gravity of the Earth does not and cannot coincide with the centre of the Earth is a problem which has never yet been investigated by astronomers or geometricians. That so slight a variation of the position of this centre of gravity as 2100 feet could produce such singular results as those demonstrated in this paper has also escaped observation. That two curves could be constructed by aid of which the changes in polar distance of stars near the pole could be measured, and the changes in right ascension of every star in both hemispheres demonstrated, is certainly a fact of some importance.

To prevent any enquiry, by suppressing a paper on this subject, is a proceeding scarcely consistent with a love of truth, or a desire for the advancement of true science.

The changes found in the zenith distance of stars were first discovered by Bradley in 1725: he states, in his paper in the "Philosophical Transactions" (1728), that he at first thought that the changes might be accounted for by Solar Nutation, but *having failed to find any movement of the Earth which could account for the observed facts*, he attributed the changes to a combination of the velocity of light and of the Earth's movements in space, and called the cause "*Aberration.*" With the permission of the Editor of this Journal I will shortly give a paper calling attention to this theory of Aberration, and comparing its value as a supposed cause with the facts resulting from the centre of gravity of the Earth not coinciding with the Earth's centre.

II. THE SOURCE OF ELECTRIC ENERGY.

By CHARLES MORRIS.

(Concluded from page 468.)

ELECTRICITY, under our hypothesis, is atomic heat. The constituents of molecules are affected differently by motions, these diverse conditions existing at the poles of the molecules, and existing separate from the movements of the molecules as wholes, precisely as these molecular movements exist separately from those of masses as wholes. This effect, as we have argued, results from the influence of similarly disturbed molecules or of molecules of different tension. If now the positive pole of one molecule vibrates to or combines with the negative pole of another, and the polarising force ceases, so that they can obey their local tendencies, what will result? The new molecule, being unaffected from without, forcibly regains the vibratory pitch in accord with its tension. This tendency affects the special atomic vibrations, which are equally above and below the normal pitch. They combine to reproduce the intermediate pitch, and thus their energy becomes heat vibration of the molecule.

Every molecule, as already stated, resists in some measure the polarising influence; and as the effect of this influence is a new distribution of the motive energies of the molecules, these become less and less forcibly disturbed outwardly from the battery. The outward pole of each molecule, whether it be negative or positive, has an excess of electric energy over the inward pole of the succeeding molecule. The sum of these excess energies must just equal the energy of the chemical action in the battery cell, ere the current can pass. And as it is this excess energy which becomes heat in the circuit, it follows that the heat produced is just equal to that necessarily arising from the chemical action. As the heat of the new-formed molecule is produced by the combination of the positive and negative vibrations, this excess of energy of one vibration over the other becomes excess heat over that possessed by the molecules before induction, and in this manner the energy of chemical action is distributed around the circuit. In good conductors the polarisation is almost

complete, and there is little heat production.* In poor conductors it is imperfect, and the excess polarisation of one molecule over the succeeding one becomes excess heat.

One cell produces negative disturbances outwardly, the other positive. These are both distinct forms of energy, and in no proper sense is one an excess and the other a lack of energy, though they may have special differences in their vigour and mode of action. But neutralisation takes place simultaneously in the two opposite directions around the circuit, the negative flow from one cell neutralising the outward positive in essentially the same manner as the positive flow from the other cell neutralises the outward negative. Probably when particles are torn off, and pass from pole to pole, it is in consequence of this opposite action of energies. And the heat which appears in this case doubtless arises from excessive resistance.

In the analogous case of contact between two oppositely charged static conductors the result is essentially as above. The positive energy of the one induces positive energy in the second; the negative of the second induces negative in the first. We may therefore view the molecules of the two conductors as vibrating at three diverse rates—the normal heat vibration, and the two abnormal electric vibrations, equidistant in pitch above and below the normal. It seems probable that these opposed efforts would combine to produce an intermediate normal vibration, the electricity being thus converted into heat. But in case either the positive or negative be in excess of the other, it does not follow that the resultant vibration will be above or below the normal. For this normal vibration is forcibly regained by the molecule as soon as the disturbing influence is removed, and any excess of electric energy continues to exist as atomic vibration. Even if it affect all the atoms of the molecule alike, it exists as an energy in discord with the normal vibration of the molecule, which possesses simultaneously two diverse vibrations—one normal, the other abnormal; one heat, the other electricity.

The views here taken as to the intimate relations which exist between the molecules of contiguous surfaces are far from telling the whole story. Still more extended relations

* In the case of the whole circuit being made up of good conductors the resistance might fall much below the polarising force. In this case only a small portion of the energy would appear as heat in the circuit, and the remainder must appear as heat at the point of chemical action. Only a portion of the energy would be needed to overcome the resistance to polarisation, and only that portion could become heat in the circuit.

exist, and every molecule is tied to every adjacent molecule by close ties of affinity. The tendency to produce conformity of molecular condition, to which we have ascribed the production of electric phenomena, goes further, and yields a resistance to every change in the motive conditions of one substance which is calculated to destroy its harmony with the motive conditions of adjacent substances. To this principle are probably due certain other effects, which are known as current induction and magnetic induction. Suppose, for instance, that two aggregates of molecules have produced their full effect upon each other, in accordance with their relations of position and constitution, and that now some new and special motive condition be given to the molecules of one of the masses. What will result? Their relations of condition will evidently be changed, and a new conformity must be established between them. Yet it seems equally evident that a resistance to this change in condition will be exerted, the two sets of molecules striving to preserve their former relations. There is a principle of inertia here displayed, and the new motion added to the one is partly prevented by, and in the same degree imposed upon, the other. There is a general principle of resistance to such changes, such as the movement of one body while the other continues at rest, or a new movement of the molecules of one while those of the other are undisturbed. And this principle of resistance produces very marked results.

If, for instance, two wires be placed in close relations of contiguity, an influence is at once exerted by each upon the other, and a certain conformity of condition established between their molecules. But if, now, one be made the conductor of an electric current, every phase of the establishment of this current will be resisted by the molecules of the second wire, and the molecules of this second wire will be forced into new relations of conformity with the changed conditions of the first. The establishment of the current is preceded by an inductive action. This is resisted by the second, and produces an opposite induction upon the second. The positive and negative polar conditions in the first are met by negative and positive polar conditions in the second. This condition in the first is followed by the current flow of positive force in one direction and of negative in the other. But this, too, is resisted. The positive poles of the molecules of the first are attractively related to the negative poles of the molecules of the second. When these positive poles of the first move forward they are retarded in their movement by the negative poles of the second, and drag these forward to

the same extent that their own movement is hindered. In like manner the movement of the negative poles of the first is hindered, and causes a like movement in the positive poles of the second. This action is followed by electric neutralisation in both wires, and must cause in the second an electric current in an opposite direction to that proceeding in the first. To the exact extent that motive energy is taken from the first it is given to the second, and the electric current in the second is the exact equivalent of that hindered in the first. The chemical energy has a greater sum of resistances to overcome, and must be more vigorous ere the current can pass. Yet this effect is only momentary. When the electric current of the first has become fully established, the hindrance of the second becomes ineffective. The condition of the first has been changed, and the second has entered into new relations with it. And a reversal of these new relations is resisted as vigorously as was the change in the primary relations. The cessation of the current experiences a hindrance from the second wire equal to that of the formation of the current. As the cessation of the current is equivalent to a backward flow of electricity, its resistance by the second wire produces a forward flow in this. Thus a return to the original relations of the two wires is accompanied by an action in the second equal and opposite to that caused in the loss of the original relations. Any partial change in the strength of the current necessarily produces similar effects to those of the complete formation or cessation of current, for each increment of current acts upon the conducting wire as though it were otherwise unaffected. And also any variation of distance between the wires strengthens and weakens their relations of mutual influence, with the accordant current effects.

If there be no second wire this principle of resistance to change manifests itself between the molecules of the primary wire. For these molecules are really independent, except so far as their mutual influence goes, this influence differing from that between the molecules of two separate wires of the same substance only in being more vigorous and less exposed to exterior substance. There is, therefore, a resistance to change of these molecular relations, possibly between the interior and surface molecules, since these surface molecules are to a certain extent affected by exterior influences. Thus, if there be no second wire, all the effects of induction are displayed in the first, through a principle of resistance to change exactly analogous to that of the former case.

As to the somewhat similar results of magnetic induction, we can only say that they display still another indication of this intimate connection between all molecules, and the effort of the molecules of each substance to hinder any change in their relations to each other, or to those of another substance. But the character of this resistance and the cause of its effects cannot be understood without a precise idea of the mode of magnetic motion. As to this we are still at a loss. The theory of Ampère, that magnetism is a result of closed electric currents circulating in parallel directions around the molecules, will not stand the test of our present knowledge of electricity. A continued electric current is impossible without there be a continued yielding of energy. Static electricity is fixed in position in fixed conditions: it only moves or varies when the shape or extent of the surface, or its relation to other surfaces, is changed. And this movement is in no sense a temporary, much less a continuous, circular current. Dynamic electricity is not a continuous, but a series of rapidly succeeding currents. For every increment of current there must be an increment of energy set free by some chemical or other agency. The idea of electric currents circulating continuously around molecules is therefore entirely at variance with the known action of electricity, and with the principle of the conservation of energy.

It is possible, however, that there may be a continuous circular motion of another kind, for atoms may be rotating spheres, disks, or rings of ethereal substance, their central attraction being a result of this rotary motion, and their exterior attractions also a result of the same motion. In the latter case the attraction would be polar, being necessarily strongest in the line of the axis, and changing to repulsion between two atoms whose rotation was in opposite directions. In a mass in which the atomic rotation was largely in one direction magnetic force would appear, and all its variations might result from the various relations of this condition between the atoms of separate masses. It is also possible that the influence of a vigorous rotary motion, like that which effectively, though not actually, exists in the inductive coil when conveying an electric current, might, by its attraction, force the atoms of another mass to assume such positions that their rotation would agree with that of the current. In such a case magnetic energy would display itself.

Reversely, the rotary energy of a magnet is resisted by the molecules of a coil into which it is introduced; and this re-

sistance produces a reverse electric current. But to understand the exact relations between the molecules of the magnet and those of the coil a more definite acquaintance with the true character of magnetic motion would be requisite. It is, doubtless, a resistance to the magnetic rotation analogous to that which displays itself in the case of current induction, but one which cannot be properly comprehended without a clear idea of the character of the centripetal motions of molecules and atoms, and their mutual attractive relations.

And as the production of harmonious relations between the molecules of a coil and of a magnet is accompanied by the formation of a momentary electric current, so in the case of a substance rotating near the poles of a magnet there is a constant change of relations, since the rotation constantly brings new sets of molecules into propinquity to those of the magnet. There arises, therefore, a constant electric current, made up of a continued series of temporary induced currents. It is not the internal motions of the magnet, but the rotary motion of the other mass, which is here converted, first into electricity, but finally into heat. The magnet, in fact, seems to exert an attractive resistance on the movement of the other body, which, under some circumstances, results in an immediate conversion of this movement into heat; but where the substance is an unbroken electric conductor, it yields first an electric current, and finally heat. This electric current shows that the magnet not only exerts an attractive resistance to the motion, but that it also produces an electric disturbance in the molecular energies. The result therefore is not increased heat-vibration, but electric neutralisation, and the phenomenon of the electric current.

Electricity is principally concerned with the relations of solid and liquid surfaces. It produces little other effect upon gases than induction. Light and radiant heat are concerned with the relations of solids or liquids to gases, or perhaps only to that ultra-gaseous form called ether. Therefore, although the innate character of this mode of motion may be the same, its vibratory pitch may widely differ, and the conditions of the substance which it affects are so widely different from those of electric substance that we cannot apply to these two series of phenomena the same methods of investigation. The movements of static electricity are towards the surfaces of a conductor. When these surfaces are accordantly electrified the energy ceases to be transmitted, and becomes truly static; but if the conductor were infinite in extent it would take an infinite period to produce this surface accordance, and the electric movement would continue inde-

finitely, or until reduced by resistance to heat. Such is the case in light transmission. Its conductor is infinitely extended. Its movement is therefore continuous, and light transmission can only cease by its gradual conversion into heat, or into some other mode of motion. Yet it is not difficult to produce a condition of radiant action somewhat similar to that existing in a charged electric conductor. For if we have a closed room bounded by reflecting surfaces, and with a source of light in its centre, there is no evidence of the accumulation of this light, however perfect the reflection may be. Each increment of the light may suffer a series of reflections, but these are instantaneous, and every successive portion of light emitted immediately ceases to be visible. When the light is quenched, or the light-yielding chemical action hindered, the light instantly disappears. What has become of it? It has not escaped from the room. It has not sunk into the wall. It has only partly been converted into static heat. Where is the remainder? Energy cannot die out. It must continue to exist in some form. If not light, or heat, or mass motion, what is this form of energy? May it not exist in a condition resembling static electricity? It is possible that the induced light energies of the interior substance of the room may be neutralised, like the induced electric energies within a charged conductor. The vanished energy may exist on the surfaces of the room precisely as static electricity exists on the surface of a conductor. No trace of this energy could possibly be discovered from the interior, on account of the interior neutralisation, on the same principle that prevents our finding electricity in the interior of a charged conductor. Nor is it possible for us to test it from without the surface, as we can electricity. There are some possible phenomena in this connection which we cannot discover. There is no evidence of a movement of light force when the surface of a room thus charged is increased by opening it into another dark room. But the action here is an induction, not a current, and would not be likely to affect the eye. Nor can we perceive any trace of outward induction of this energy through the confining walls. And yet it is not quite illogical to argue that light and electricity are like modes of motion, and that the reason we cannot discover every phenomenon of the one in the other is simply because we cannot subject them to the same processes of investigation.

If there really exists such a similarity between light radiation and electric radiation, the action of light would not resemble the movement of an electric current through the

connecting-wires of a battery. Its true analogy would be to the movement of static electricity through the interior of a conductor, the effort not being towards neutralisation, but towards surface change. And in this case the infinite extent of the conductor causes an infinitely continued movement of the unabsorbed portion of the energy. All the spheral orbs of space may really occupy interior relations to the conductor of cosmical radiance, and thus be incapable of light electrisation.

The great diversity in the pitch of light-vibrations may arise from another cause. There is incessant change in the relations of molecules by which these radiant vibrations are produced. The molecules now separate from each other, now come into contact. Their relations of distance, and thus of mutual polarisation, are constantly diversified. And if the radiant vibrations result from mutual action under these diverse relations, they might possibly differ very greatly in pitch, waves of different pitch succeeding each other with great rapidity. This idea, of course, is but conjectural, and advanced as a mere hint at the possible cause of these variations.

III. HYLOZOISM *versus* ANIMISM.

By C. N. Communicated by Dr. R. LEWINS.

"God is a blank sheet, on which nothing is found but what we ourselves have written."—LUTHER.

I MUST beg to express my deep sense of obligation to Mr. Barker for his ingenious criticism, in your July issue, of the article entitled "Hylozoic Materialism," which I contributed to the June No. of this Journal. No one can do me a greater service than by most rigidly and severely scrutinising the "weight and measure" of my arguments; and I am not only willing, but anxious, that they should be submitted to such a test.

I need hardly say that the word "Hylozoism," being derived from the Greek *Hyle*, matter, and *Zoe*, life, signifies the doctrine of the inherent and inseparable vitality or

energy of matter. So far from being a new or unintelligible compound it is constantly used by Cudworth, in his great work on the "Intellectual System." It has been since so familiarised by other thinkers that the term will be found in any complete dictionary of our language.* Life, in its simplest and broadest sense, may be defined as potential activity, accompanied or not by the powers of reproduction and sensation; and it is a firmly established axiom of contemporary science that such life or activity belongs to every atom of the material universe. Yet, though the theories of ancient deductive philosophy are reduced by the inductions of modern physics to definite formulæ, Hylozoic Materialism is essentially identical with that of Democritus, Epicurus, Lucretius, and of all, ancient or modern, who have rejected the supernatural element from their *rationale* of existence. It is not surprising that so simple a generalisation should appear "wild and extravagant" to those who find it easy to repose their faith in spiritual mysteries; for the mind of man is always more strongly attracted by complex fictions than by plain facts. Not till he has woven and rejected or worn out successive garbs of fable can he bear to gaze upon the naked truth; and this explains the hostility which Materialism has encountered from many grand and subtle intellects, who have chosen to deck Nature with false jewels instead of seeking docilely for her native treasures. It is true that the ignorant have displayed equal antagonism, but their ignorance has been imitative, not primitive, and they have only followed blindly in the wake of their betters. Children and savages are with difficulty made spiritualists, though their instinctive, necessarily empirical, Hylozoism is complicated by the influence of fear, wonder, and of that natural tendency to personification which is the parent of poetry and religion. In the same way men of science, even though they may recognise the fallacy of Dualism, are often too apt to literalise metaphors and regard abstractions as entities. Consciously or unconsciously they elevate Force, which is but a function, to the rank of an agent; and of this erroneous conception I find an apposite example in Mr. Barker's letter.† He says, on p. 428 ("Journal of Science" for July), "But will C. N. contend that nothing has a real

* In connection with this theorem of "Life and Mind" the articles "Cudworth" and "Animism," in the new edition of the "Encyclopædia Britannica," are worth the perusal of those interested in the subject. Liddell and Scott's Greek and English Lexicon may also be turned to with profit. Hylozoism is the exact equivalent of Non-Animism, the antithesis of Animism.—R. L.

† As a further example of the confusion still existing in the scientific mind on this subject, see Prof. Tait's Lecture, a few years since, at the Glasgow

existence but that which is cognisable by our senses? Then he must give up his belief in the existence of almost every force in Nature,—*e.g.*, magnetism or electricity, for he cannot see them; indeed he cannot *see* the force in his own arm, he can only *infer* it from its visible effects; *or*, from conscious feeling in his mind that he possesses it." I accept the illustration: for the forces of magnetism and electricity, of heat, light, gravitation, and muscular motion are not independent and separable entities, but special forms of that universal activity which is an inalienable function of Matter. I believe in the effects which I see and feel, not in a hypothetical and wholly superfluous "cause." In the next sentence I find the assertion that "the very fact of our consciousness that we can, at will, exert force upon matter, proves that there is something in our bodies superior to matter, and therefore necessarily distinct from, however associated with, matter." I fail to understand the cogency of this reasoning. It seems to me that the phrase "superior to matter" begs the whole question in dispute; for if, as I contend, our physical structure is capable of thought and sensation, it possesses the attributes usually assigned to "spirit;" and thus complementary qualities, usually supposed to be divided between two entities, are united in one. Except on the principle that half is more than the whole, I do not see how a perfect being can be inferior to an imperfect one, and the very word "immaterial" implies defect and limitation. The fact that "we can, at will, exert force upon matter," does not prove the existence within our bodies of an "*anima*" or immaterial principle. One stone attracts another; is it therefore *animated* or inspired by some essence superior to stone? The brain acts upon the body, of which it is a part; but this, like the action of wind upon water, of the sun on a planet, is the effect of a relation between matter and matter, not between matter and "spirit."

Unless it can be shown that certain nervous and muscular motions are caused by conscious volition apart from organisation, there remains no function for the soul, nor any method by which it can manifest itself in the outer world. If "will" be destitute of dynamic power it is a nonentity and illusion; and this is the plain teaching of modern Physiology and Pathology. That motion, even when apparently intelligent, may be unaccompanied by thought or

Meeting of the "British Association for the Advancement of Science," in which he rejects, most summarily, Dr. Tyndall's conception of "Force," as enunciated in the latter's Presidential Address at Belfast.—R. L.

sensation, and due to purely physical causes, is clearly proved by the phenomena of reflex action in paralytics and in decapitated animals; and if such movements, originating in the spinal cord, are automatic, we can hardly assign a different character to those manifested by the cerebral hemispheres, since the mode of action of all the different nerve centres is essentially the same. It is surely far more credible and rational that consciousness, like other bodily functions, is evolved by complexity of organisation, than that one portion of the nervous system is self-working, while another is subjected to the constant interference of an indwelling spiritual power. The *vis insita* of matter (which etymologically means *indwelling*, but practically means *inalienable* force) supplies the place of the Divine afflatus, and affords, in the strictest sense of the phrase, a logically sufficient "cause"—*i.e.*, a *rationale* reducing apparently anomalous phenomena to a familiar category. We know that increase of weight by calcination results from chemical combination with oxygen, or other supporter of combustion, and therefore dismiss the old theory of a separable levitating factor (*phlogiston*), thus refusing to "assume two principles where one is sufficient." The dualistic hypothesis of matter and spirit is only a wider generalisation of the pre-Lavoisierian fallacy. I do not, of course, deny "what is called a chain of causation," *where it can be discovered;* but where there is no trace of such a chain neither Science nor Philosophy is authorised to assume its existence.

No doubt "the worst and most absurd errors are often"—I would say *always*—"the corruptions or exaggerations of truths." But in such cases the evidence must be stronger on one side than on the other; the reality must be more strongly supported than the simulacrum; and until I am informed in what respect the evidence for the existence of fairies, goblins, and witches fall below that for the existence of the soul, my argument is untouched. We know that men see visions and dream dreams, that their thoughts and feelings are capable of higher development and of more indefinite range than those of the brutes; and truths such as these have been corrupted into the errors of Dualism.

Mr. Barker somewhat misapprehends the significance of my illustration drawn from the phenomena of isomerism. I wished to show that as the same components might combine in the same proportions to form an odorous or an inodorous, a hurtful or a harmless compound, so the same particles might unite in a sentient or non-sentient organism. In the former case, as Mr. Barker himself observes, no one postu-

lates the exit or entrance of a spiritual poison or odour; why then superadd a "soul" or thinking essence in the latter? I pass by the assertion that volition "cannot be reasonably ascribed to mere matter," only remarking that no property whatever can be "reasonably ascribed" to a hypothetical phantom like "spirit." That animal life is the outcome of certain chemical processes, upon which its energy and continuance are entirely dependent, appears to me as certain a proposition as that the combustion of a candle results from the combination of its carbon and hydrogen with the oxygen of the atmosphere. The two cases are strictly analogous; but the oxidation which sustains and vivifies our animal frame takes place under more complex conditions, and kindles a slower non-incandescent fire.

Mr. Barker regards "sensation as belonging to (not proceeding from) the nervous tissue; but perception of that sensation as belonging to the living *anima* associated with it, exclusively." The distinction between "belonging to" and "proceeding from" is not very clear; and it is evident that perception, emotion, and thought are simply the special sensations or functions of the grey vesiculo-neurine of the encephalon, upon the healthy condition of which their sanity depends, just as sight depends on the eye and hearing on the ear. If matter be simply an inert machine, which must be kept in good order that it may obey the impulse and behests of its ghostly *Archæus*, how shall we account for the fact that a merely physical stimulus—as of alcohol, opium, &c.—may suffice to change the whole current of thought and feeling? Surely this is a case of the fiddle playing on the musician!

I have reserved for the conclusion of this letter a few remarks on Mr. Barker's theosophistical speculations, which, as outside Reason, do not properly fall within the scope of a scientific argument. He will see, by a reference to my article, that the quotation from Dr. Lewins' tract, "Life and Mind," ran thus:—"*The question of* the *anima mundi* and the *anima humana* is, at bottom, one and the same." By leaving out the first three words he has incorrectly construed the sentence into the admission of the existence of a cosmic and human soul. All energy is of course an attribute of some being,—*i.e.*, of something which exists; but we need not therefore assume that this being is personal or conscious. Intelligent agents exercise energy; but this does not involve the converse proposition, that all energy must originate in a conscious agent. An "Infinite Mind" giving "existence to finite minds" must be limited by its own creations, and

therefore be at once infinite and finite. Is not this an unthinkable paradox? If there be an *Omnipresent* Deity, nothing else can have any real existence, and he must be the noumenon of which the Universe, subjective and objective, is the phenomenon. It signifies little whether this one and indivisible Reality be spoken of as God, Force, or Matter (though the last term is preferable, as being the simplest and least liable to misconstruction), for *to us* it is practically non-existent. No man can transcend his own Egoity or individual subjective Cosmos, of which his brain is the sole proplasm, though he may people it with Jehovah and his hierarchy of angels and archangels, "good" and "evil," with the humanised gods of Hellas, with the New Testament Trinity, or with the saints and witches, goblins and fays of the Middle Ages. Neither reflection nor imagination will enable him to get "behind" Nature,—itself only a mental abstraction,—or penetrate to the substratum of his own being. If he believe in an Omnipresent God, he is, as I have shown, logically compelled to Monism; if not, he rejects "Revelation," and certainly will find in Science and Reason no foundation for Dualism. From this dilemma he cannot escape, and should esteem himself happy that "salvation" or *health*—the *mens sana in corpore sano*—does not depend upon the attainment of the unattainable, but is placed within the sphere of his own knowledge and capacity.

PS. I regret that I had not observed the correction of the statement respecting vegetable protoplasm in Mr. Barker's paper.

IV. A GEOLOGICAL IDEA OF LORD BACON'S.

By Dr. O. Reichenbach.

LORD BACON, not yet knowing of Australia, already drew attention to the southward directed points of continents as probably due to a common cause in the evolution of the Earth. The hint has been of no value to Science.

Lord Bacon was not a physicist, and not at all a mathematician, but surely a man of great philosophical instincts. As Englishmen may be proud of this countryman, some scientists amongst them may perhaps feel disposed to attentively read an article which shows the causation in the position and distribution of these points.

A planetary mass divided into planets, similarly as did Biela's comet.

The earth turned off the moon and rings, as Saturn has got them.

The rings returned to the earth, and spread out into envelopes.

Rings away from the planet are disturbed by sun and moons, so are envelopes in contact. A distant ring revolves, and envelopes in contact continue to revolve. Their slackened rotation generates friction and heat, which depend on the relative weights, densities, molecular conditions, and stages of evolution.

The polar axis is not only shorter than the equatorial, but both axes have a long and a short branch. Measured meridians confirm this. This means unequal density of the hemispheres; consequently an unequal distribution of sea, west and east, south and north. The eccentricities of both axes are the same; they co-determine the mutual action of the inner planet with its envelopes. South and west are the more condensed hemispheres; they exceed north and east in the mass of sea, not only in proportion to surfaces of sea, but they possess by a regionally greater depth of sea a further excess of water, amounting for each of the respective hemispheres to 1-29·78 of the mass of the sea. 1-29·78 of the axis of the orbit is the difference of greatest and least distance of earth and sun. The eccentricity of the polar or equatorial axis is 1-3546 the square of the eccentricity of the orbit. The sea, in the mean 15,180 feet deep, is 1-3546 of the mass of the earth.

The fluid remnants of descended rings of catastrophic rains, or downpours of solids, liquids, and gases, during periods of earthquakes, electric commotions, and magnetic constitutions, are the sea.

The sea is an envelope decomposed into four rings,—two equatorial, two polar.

The solid envelope has a less density than the mean one of the earth. It is separated from a nucleus by a mere elastic stratum, becoming locally solid, liquid, and gaseous. The envelope thus may slide on the nucleus.

The weight in motion of the sea rings acts tangentially on

the envelope; it moves it, and produces friction and heat in the interstratum, during progressive condensation interrupted by expansion. This internal heat keeps the envelope malleable and pliable, and the tangential force of the sea lifts and folds a portion of it into continents equal in weight to the sea. The sea gets imbedded between the folds, and raises—by arrested motion and an excess of specific gravity—land above its level to a mean height of 1018 feet, 1-14·78 of its own mean depth.

As the crystal has its angles and faces as results of a past, thus has the earth its features as gradual results of the tangential work of the sea on the envelope, and *through it* on the interior.

No law is absolute. The law of A is always interfered with by that of B.

No relation of figures or features I give I claim to be absolutely correct. Carping at my figures may be sometimes easy without being wise.

Poles, equator, polar and tropical circles are features bounding zones which are the means for less regularly shaped meteorological zones.

The arc from the pole to its circle is 23° 28′; the remaining arc to the equator is 66° 32′. These arcs are 1 : 2·83. The extent of land to sea is 1 : 2·83. The density of the water in the sea to that of the envelope, and of the land *to the mean depth of* 1518 *feet from sea-level*, is 1 : 2·83. The masses of the water and the folded land are equal. That water contains salts and land rises above the sea are modifying details.

23° 28′ goes twice into 66° 32′, or thrice into 90°, leaving a remainder of 19° 34′. In all 2·83 and 3·83 times to complete the 3 and 4 we have to borrow 3° 52′ beyond the equator. The polar zones are like stones alternately thrown into the halves of a pond—they produce waves.

The centrifugal action of each hemisphere has its mean limit in the equator for the whole earth,—not for the sea, envelope, or nucleus separately. The 3° 52′ are nodal bands between waves 19° 14′ wide, propagated from hemisphere to hemisphere.

The sinus of an angle of 3° 52′ is 1-29·78 of the radius. There are connections. The inclination of the axis on the orbit and the eccentricity of the orbit are conflicting and compromising subjects of sovereign gravity.

If the density of the earth had been equal north and south, not west and east, and the equator had coincided with the orbit, and the relative densities of sea and envelope had

been the present, the folds ever raised laid bare and submerged, never permanently constituted, would have presented a transitory appearance whose image we may trace in the equator, where the effects from either side consequent on centrifugality tend to balance each other.

Three land segments traverse the equator. This is analogous to the perturbations suffered by the moon. The first one commences on the west coast of America, between the deepest waters in the West Atlantic and East Pacific, at Pr, the pericentre of the nucleus in the equator. Counting meridian Pr 0°, segment Pr occupies 31° 20′. Segment Af, commencing with 90° E. long., again occupies 31° 20′.* Segment Ap we meet in 180 E. long.; it extends from Sumatra beyond Gilolo to the east of Waggiou, through 31° 20′, not entirely occupied by land, but the segment is well defined by continental islands west and east. We thus have in the equator land formation $31° 20' \times 3 = 97°$, to the remaining 266° of ocean 1 : 2·83.

Globe I. shows the three segments from pole to pole. The land within is 0·512 of all land; the remaining 0·468 are around. The land of two segments is partly contiguous; the boundary corresponds to *geological and organic* characteristics. The middle segment, with the greatest mean elevation, is entirely opposite to ocean.

This is the prototype which always tended to form, but never formed; like an embryo contending to develop one form, but by interference bound to adopt another.

Folds from pole to pole would be barriers against their cause—the revolution of an ocean and the circulation of ocean rings *parallel* to the equator and a coinciding orbit.

Any outside body which disturbs equality of density and of distribution of weight to the sides of this equator produces a perturbation in latitude which causes the ocean to *break through* the folds rising perpendicularly to the equator, makes the equator inclined on the orbit, maintains the circulation of the ocean round the earth by engendering polar streams, and allows the poles to develop themselves to an oscillatory permanency. It allows the earth animal to live; its blood circulates, its heart beats: when the ocean stops, the corpse descends to the sun, which finally also dies.

The continents have been tangentially folded by the sea, and perpendicularly lifted by the expansive powers of its substances present and penetrating below the envelope.

The inequality of density and mass has been developed in

* Globes as referred to may be seen at the South Kensington Museum.

south and north symmetrically with west and east. The density of sea to land is 1 : 2·83; the extent of land to sea is 1 : 2·83; the land south to north is 1 : 2·83 (altered by tertiary reasons into 1 : 2·73). The sum of the parallels of 45′ cuts 1 land to 2·83 sea; the land arc at the south is to that at the north as 1·01 : 11·07, as the height of the polar zones to that of the remaining sphere.

A planet or moon does not uniformly describe an ellipsis, but a chain of waves with varying velocities. Thus is the motion of ocean rings round an eccentric planet perturbed in longitude and latitude. From the first these rings must have accommodated themselves to the continents they raised.

The circulation of the ocean, and with it the vibration of the land, has been decomposed into four intertwining rings, two equatorial, two polar; and their normal mean orbits, or lines of intensity, from which the water is made to deviate, present, drawn through sea and land, four great curves, whose apsides we find by reasoning and by the distribution of sea and land.

We had as equatorial pericentre of the inner earth, Pr; as apocentre, Ap. The equatorial lines of intensity of sea and envelope, at their mean,—that is, at absolute surface,—have their pericentres 23° 28′ north and south on meridian Pr, and their apocentres on Ap; they are tangent to the tropical circles. The polar lines have their pericentres in V and I 90° west of Pr, and their apocentres at L and M on the polar circles.

V coincides with the region from where the tides start. L is the Maelstrom of old fame; I falls into Behring's Straits; M into nameless parts. From L to S the arctic circle crosses 180° of land. The sum of the polar circles crosses 360° of land and 360° of sea. The antarctic circle $(\sqrt{2{\cdot}83})^3 = 4{\cdot}78$ of ocean to 1 of land; the arctic the opposite.

West of the meridian circle, Pr, Pn, Ap, Ps (Ps the south).

In the North Pole there is 1-27th of all land more than south of the equator; but when we lay through Pr Ap a circle anywhere between 10° 42′ to 11° 59′ from Pn towards I, it divides the land 1 : 2·83. A circle laid through Pr Ap, south of I on meridian S V, anywhere between 34° 12′ to 55° 48′, divides the land $1 : 2{\cdot}83^2 = 1 : 8{\cdot}008$.

The sea which—less dense than the earth—stays behind in rotation will try to break through the prototype where gravity in the equator is absolutely greatest. The barriers

will be folded in latitude. The break will be driven from that hemisphere where gravity and the mass of the sea are greatest towards the other; from round Ps, where gravity on the earth is greatest, and the sea is deepest towards Pn. The interval between folds will be moved from the equator towards the north.

Globe III. thus shows that the segment Pr has been divided into two equal halves by the reflux of the sea. These halves are connected by an isthmus. Isthmuses, islands, peninsulas, certain regions, are the results of conflicting proportions; two or more contradictory conditions must be compromised; interference waves, supplements, are the consequence.

If a mass of liquid, equal in extent, depth, and density in the respectively equal parallels, moved in retrogression and progression, parallel with an equator coinciding with the orbit, striking the solid according to the apsides of the parallels first in the pericentric meridian Pr, the forming folds would coincide with the meridian. But when the sums of striking forces become unequal to the sides of the equator the fold must become inclined to meridian Pr, which itself will not be exempt from motion over the nucleus reacting by elasticity.

The inequality of forces moving the fold to the incline is represented by two equal forces acting in opposite senses, gradually moved from the points Ps and Pn towards Pr, and by the plus of force consequent on the greater condensation, and consequently greater mass of liquid in one hemisphere, which causes this liquid, having a depth beyond the mean one, to press, move, and fold from Ps towards Pn, causing an increasing reaction of folding from Pr back towards Ps.

The varying differences between the equal forces and the plus determine the quantities and senses of absolute sliding of the envelope V, and its single strata over the nucleus. It is the inequality of masses and distribution of forces in any pair of hemispheres, and the difference of inner attraction of solid and liquid envelope, that is of elasticity, which determines the size of folds and their subdivision, and opens the passage for a complete circulation of the sea.

The polar zones contain land to sea 1 : 2·83; the tropical zones contain—

$$\frac{1}{29{\cdot}78} + \frac{1}{287} + \frac{1}{3546} = \frac{1}{27}$$

of all land less than 1 of land to 2·83 of sea; the middle zones so much more.

By the overweight of the sea round Ps, consequent on a greater regional condensation of the nucleus by external influences, the envelope at the south has been smoothed away from Ps, and raised and plicated towards the north. The mass above the lower zero level of land and sea has been increased at the north; the interstratum, having been heated, expanded, made less dense and more elastic, by the fall, penetration, and internal heat effect of water from the south.

Folds are the accumulated remainders of continued oscillations: the world is built up by oscillations, all referable to gravity.

I directly connect the waves of sea and land, but a comparison will more easily be appreciated. The number of vibrations of blades of equal material and dimensions, length excepted, are in equal times inversely as the squares of these lengths. Imagine land and sea formed into blades equally broad and thick, and fixed at respective points, poles, they will be in length $1 : 2{\cdot}83$. The sun is the bow setting them in vibration.

If sea and land were of equal material the frequency of vibrations would be $2{\cdot}83^2 : 1$, but the land is $2{\cdot}83$ times more dense. The vibrations of chords or blades of equal dimensions, but different material, are, in like times, in frequency inversely as the square roots of the densities; the rotation becomes $(\sqrt{2{\cdot}83})^3 : 1 = 4{\cdot}78 : 1$.

Both these and all further developed undulations will be represented in land and water,—the one directly, the others by induction through the other element. Thus the land south to north is $1 : 2{\cdot}83$, and the extreme division of land by hemispheres is $2{\cdot}83^2 : 1$. As undulations produce heat in air and sounding-board, they produce it in land and water.

Globe II. presents the deutotype. It shows the prototypic segment Pr moved to an incline of $23^\circ\ 28'$ to meridian Pr; its basis is tangent to the polar circles in S and M. The motion has been reciprocal with the developed inclination of the equator on the orbit.

Segment Ap is equally inclined; its basis is tangent to the polar circles in V and L. The middle segment occupies the prototypic position; it bars equatorial circulation.

The sum of land inside the segments is to that outside $\sqrt[4]{(2{\cdot}83)} : 1$. The land outside is closely around, with the exception of the antarctic section belonging to segment Pr. On Globes II. and III. surfaces of land outside correspond to equally coloured ocean surfaces inside.

The sections into which these segments have been divided are each composed of an oblong and a triangle, of a large wave crossed by a small one; but circles represent on Globe III. conveniently the mean surfaces and characteristics.

Meridian circle Af passes through L and S. The meridian circle which equally divides segment Af in the equator, equally divides the land belonging to segment Af, and also all land and sea generally. The configuration of the earth seen in the profile of this circle shows the symmetry of the halves.

Segment Pr is divided into four sections; the extremes, the arctic and antarctic, are equal, so are the middle ones. Each extreme is to each middle $1 : (\sqrt{2}\cdot 83)^3 = 1 : 4\cdot 78$.

The middle sections are connected by an isthmus; the extremes are divided into archipelagos by the ocean rings in their tendency to maintain the circulation of the water complete in the amalgamated senses of longitude and latitude, with separation of retrogressing and progressing streams, of *arteries* and *veins*.

Segment Pr gets not only inclined and divided: it is, together with Ap and Af, pushed north by the 1-29·78 of surplus water by depth round Ps and its zone, the region of absolutely greatest gravity.

The parallel 34° 12′ from Ps divides half the prototypic segment Pr in proportion $1 : (\sqrt{2}\cdot 83)^3 = 1 : 4\cdot 78$. This is 10° 44′ outside the antarctic circle. The southern point of America is 10° 44′ from that circle.

(To be continued.)

V. ON DIPTERA AS SPREADERS OF DISEASE.

By J. W. Slater.

THE two-winged flies, in their behaviour to man, stand in a marked contrast to all the other orders of insects. The Lepidoptera, the Coleoptera, the Neuroptera, the Hymenoptera no doubt occasion, in some of their forms at least, much damage to our crops. But none of them are parasitic in or upon our bodies; none of them persistently

intrude into our dwellings, hover around us in our walks, and harass us with noise and constant attempts to bite, or at least to crawl upon us. Even the ants, except in a few tropical districts, rarely act upon the offensive. The Hemiptera contain one semi-parasitic species which has attained a "world-wide circulation," and one degraded, purely parasitic group. But the Diptera, among which the fleas are now generally included as a degenerated type, comprise more forms personally annoying to man than all the remaining insect orders put together. These hostile species are, further, incalculably numerous, and occur in every part of the globe. Mosquitoes swarm not merely in the swampy forests of the Orinoco or the Irrawaddy, but in the Tundras of Siberia, on the storm-beaten rocks of the Loffodens, and are even encountered by voyagers in quest of the North Pole. The common house-fly was probably at one time peculiar to the Eastern Continent, but it followed the footsteps of the Pilgrim Fathers, and is now as great a nuisance in the United States and the Dominion as in any part of Europe. It is curious, but distressing, to note the tendency of evils to become international. We have communicated to America the house-fly and the Hessian fly, the "cabbage-white," the small-pox, and the cholera. She, in return, has given us the *Phylloxera*, a few visitations of yellow fever, the *Blatta gigantea*, and, climate allowing, may perhaps throw in the Colorado beetle as a make-weight. In this department, at least, free trade reigns undisputed. It is a singular thing that no beautiful, useful, or even harmless species of bird or insect seems capable of acclimatising itself as do those characterised by ugliness and noisomeness.

But, returning from this digression, we find in the Diptera the habit of obtrusion and intrusion, of coming in actual contact with our food and our persons, combined with another propensity—that of feeding upon carrion, excrement, blood, pus, and morbid matter of all kinds. This is a combination far more serious than is generally imagined. If the fly—which may at any moment settle upon our lips, our eyes, or upon an abraded part of our skin—were cleanly in its habits, we need feel little annoyance at its visits. Or if it were the most eager carrion devourer, but did not, after having dined, think it necessary to seek our company, we might hold it, as is done too hastily by some naturalists, a valuable scavenger. I fear, however, that I have already made too great a concession. So long as very many persons are suffering from disease,—so long as many diseases are capable of being transmitted from the sick to the healthy,—

so long must any creature which is in the habit of flying about, and touching first one person and then another, be a possible medium of infection and death.

Let us take the following case, by no means imaginary, but a generalisation from occurrences far too frequent:—A healthy man, sitting in his house or walking in the fields, especially in countries where the insectivorous birds have been shot down, suddenly feels a sharp prick on his neck or his cheek. Putting his hand to the place he perhaps crushes, perhaps merely brushes away, a fly which has bitten him so as to draw blood. The man thinks little of so trifling a hurt, but the next morning he finds the puncture exceedingly painful. An inflamed pimple forms, which quickly gets worse, whilst constitutional symptoms of a feverish kind come on. In alarm he seeks medical advice. The doctor tells him that it is a malignant pustule, and takes at once the most active measures. In spite of all possible skill and care the patient too often succumbs to the bite of a *mouche charbonneuse*, or carbuncle-fly. But has any kind of fly the property of producing malignant pustule by some specific inherent power of its own? Surely not. The antecedent circumstances are these:—A sheep or heifer is attacked with the disease known in France as *charbon*, in Germany as *milz-brand*, and in England as *splenic fever*. Its blood on examination would be found plentifully peopled with bacteria. If a lancet were plunged into the body of the animal, and were then used to slightly scratch or cut the skin of a man, he would be inoculated with "charbon." The bite of the fly is precisely similar in its action. Its rostrum has been smeared with the poisoned blood, an infinitesimal particle of which is sufficient to enclose several of the disease-"germs," and these are then transferred to the blood of the next man or animal which the fly happens to bite. The disease is reproduced as simply and certainly as the spores of some species of fern give rise to their like if scattered upon soil suitable for their growth. But flies which do not bite may transfer infection. Everyone must know that if blood be spilt upon the ground a crowd of flies will settle upon and eagerly absorb it. Animals suffering from splenic fever in the later stages of the disease sometimes emit bloody urine. Often they are shot or slaughtered by way of stamping out the plague, and their carcases are buried deep in the ground. But some loss of blood is sure to happen, and this will mostly be left to soak into the ground. Here again the flies will come, and their feet and mouth will become charged with the contagion. Such a fly, settling upon another animal

or a man, and selecting—as it will do by preference, if such exist—a wound, or a place where the skin is broken, will convey the disease.

Again, M. Pasteur has thoughtfully pointed out that if an animal has died of splenic fever, and has been carefully buried, the earth-worms may bring up portions of infectious matter to the surface, so that sheep grazing, or merely being folded over the spot in question, may take the plague and die. Hence he wisely counsels that the bodies of such animals should be buried in sandy or calcareous soils where earth-worms are not numerous. But it is perfectly legitimate to go a step farther. If such worm-borings retain the slightest savour of animal matter, flies will settle upon them and will convey the infectious dust to the most unexpected places, giving wings to the plague.

Now it is very true that no one has seen a fly feasting upon the blood of a heifer or sheep dying or just dead of splenic fever, has then watched it settle upon and bite some person, and has traced the following stages of the disease. But it is positively known that a person has been bitten by a fly, and has then exhibited all the symptoms of charbon, the place of the bite being the primary seat of the infection. We know also, beyond all doubt, the eagerness with which flies will suck up blood, and we likewise know the strange persistence of the disease "germs."

Again, the avidity of flies for purulent matter is not a thing of mere possibility. In Egypt, where ophthalmia is common, and where the "plague of flies" seems never to have been removed, it is reported as almost impossible to keep these insects away from the eyes of the sufferers. The infection which they thus take up they convey to the eyes of persons still healthy, and thus the scourge is continually multiplied.

A third case which seems established beyond question is the agency of mosquitoes in spreading elephantiasis. These so-called sanitary agents suck from the blood of one person the Filariæ, the direct cause of the disease, and transfer them to another. The manner in which this process is effected will appear simple enough if we reflect that the mosquito begins operations by injecting a few drops of fluid into its victim, so as to dilute the blood and make it easier to be sucked.

So much being established it becomes in the highest degree probable that every infectious disease may be, and actually is, at times propagated by the agency of flies. Attention turned to this much neglected quarter will very probably go

far to explain obscure phenomena connected with the distribution of epidemics and their sudden outbreaks in unexpected quarters. I have seen it stated that in former outbreaks of pestilence flies were remarkably numerous, and although mediæval observations on Entomology are not to be taken without a grain of salt, the tradition is suggestive. Perhaps the Diptera have their seasons of unusual multiplication and emigration. A wave of the common flea appears to have passed over Maidstone in August, 1880.

We now see the way to some practical conclusions not without importance. Recognising a very considerable part of the order of Diptera, or two-winged flies, as agents in spreading disease, it surely follows that man should wage war against them in a much more systematic and consistent manner than at present. The destruction of the common house-fly by "*papier Moure*," by decoctions of quassia, by various traps, and by the so-called "Catch 'em alive," is tried here and there, now and then, by some grocer, confectioner, or housewife angry at the spoliation and defilement caused by these little marauders. But there is no concerted continuous action,—which after all would be neither difficult nor expensive,—and consequently no marked success. Experiments with a view of finding out new modes of fly-killing are few and far between.

Everyone must occasionally have seen, in autumn, flies as if cemented to the window-pane, and surrounded with a whitish halo. That in some seasons numbers of flies thus perish,—that the phenomenon is due to a kind of fungus, the spores of which readily transfer the disease from one fly to another,—we know. But here our knowledge is at fault. We have not learnt why this fly-epidemic is more rife in some seasons than others. We are ignorant concerning the methods of multiplying this fungus at will, and of launching it against our enemies. We cannot tell whether it is capable of destroying *Stomoxys calcitrans*, the blowflies, gadflies, gnats, mosquitoes, &c. Experiment on these points is rendered difficult by the circumstance that the fungus is rarely procurable except in autumn, when some of the species we most need to destroy are not to be found. Another question is whether the fungus, if largely multiplied and widely spread, might not prove fatal to other than Dipterous insects, especially to the Hymenoptera, so many of which, in their character of plant-fertilisers, are highly useful, or rather essential to man.

Another fungus, the so-called "green muscardine" (*Isaria destructor*), has been found so deadly to insects that Prof.

Metschnikoff, who is experimenting upon it, hopes to extirpate the *Phylloxera*, the Colorado beetle, &c., by its agency.

Coming to better-known and still under-valued fly-destroyers, we have interfered most unwisely with the balance of Nature. The substitution of wire and railings for live fences in so many fields has greatly lessened the cover both for insectivorous birds and for spiders. The war waged against the latter in our houses is plainly carried too far. Whatever may be the case at the Cape, in Australia, or even in Southern Europe, no British species is venomous enough to cause danger to human beings. Though cobwebs are not ornamental, save to the eye of the naturalist, there are parts of our houses where they might be judiciously tolerated: their scarcity in large towns, even where their prey abounds, is somewhat remarkable.

But perhaps the most effectual phase of man's war against the flies will be negative rather than positive, turning not so much on putting to death the mature individuals as in destroying the matter in which the larvæ are nourished. Or if, from other considerations, we cannot destroy all organic refuse, we may and should render it unfit for the multiplication of these vermin. We have, indeed, in most of our large towns and in their suburbs, abolished cesspools, which are admirable breeding-places for many kinds of Diptera, and which sometimes presented one wriggling mass of larvæ. We have drained many marshes, ditches, and unclean pools, rich in decomposing vegetable matter, and have thus notably checked the propagation of gnats and midges. I know an instance of a country mansion, situate in one of the best wooded parts of the home-counties, which twenty years ago was almost uninhabitable, owing to the swarms of gnats which penetrated into every room. But the present proprietor, being the reverse of pachydermatous, has substituted covered drains for stagnant ditches, filled up a number of slimy ponds as neither useful nor ornamental, and now in most seasons the gnats no longer occasion any annoyance.

But if we have to some extent done away with cesspools and ditches, and have reaped very distinct benefit by so doing, there is still a grievous amount of organic matter allowed to putrefy in the very heart of our cities. The dust-bins—a necessary accompaniment of the water-carriage system of disposing of sewage—are theoretically supposed to be receptacles mainly for inorganic refuse, such as coal-ashes, broken crockery, and at worst the sweepings from the floors. In sober fact they are largely mixed with the rinds, shells, &c., of fruits and vegetables, the bones and heads of

fish, egg-shells, the sweepings out of dog-kennels and hen-houses, forming thus, in short, a mixture of evil odour, and well adapted for the breeding-place of not a few Diptera. The uses to which this "dust" is put when ultimately fetched away are surprising: without being freed from its organic refuse it is used to fill up hollows in building-ground, and even for the repair of roads. A few weeks ago I passed along a road which was being treated according to the iniquity of Macadam. Over the broken stones had been shot, to consolidate them, a complex of ashes, cabbage-leaves, egg- and periwinkle-shells, straw, potato-parings, a dead kitten (over which a few carrion-flies were hovering), and other promiscuous nuisances. The road in question, be it remarked, is highly "respectable," if not actually fashionable. The houses facing upon it are severely rated, and are inhabited chiefly by "carriage people." What, then, may not be expected in lower districts?

Much attention has lately been drawn to the fish-trade of London. It has *not*, however, come out in evidence that the fish-retailers, if they find a quantity of their perishable wares entering into decomposition, send out late in the evening a messenger who, watching his opportunity, throws his burden down in some plot of building land, or over a fence. When I say that I have seen in one place, close alongside a public thoroughfare, a heap of about fifty herrings, in most active putrefaction and buzzing with flies, and some days afterwards, in another place, some twenty soles, it will be understood that such nuisances can only be occasioned by dealers. To get rid of, or at least greatly diminish, carrion-flies, house-flies, and the whole class of winged travellers in disease, it will be, before all things, essential to abolish such loathsome mal-practices. The dust-bins must cease being made the receptacle for putrescent and putrescible matter, the destruction of which by fire should be insisted upon.

The banishment of slaughter-houses to some truly rural situation, where the blood and offal could be at once utilised, would be another step towards depriving flies of their pabulum in the larva state. An equally important movement would be the substitution of steam or electricity for horse-power in propelling tram-cars and other passenger carriages, with a view to minimise the number of horses kept within greater London. Every large stable is a focus of flies.

VI. THE TRANSFER OF SENSATION.

THE recent discoveries based on the conversion of electric currents into sound-vibrations have suggested the possibility of greater and wider results in the future. Is it not possible to convert light into electricity, and by this means to see objects and witness events not merely at great distances, but in spite of intervening objects. Is it not conceivable that the phenomena which depend on the absorption and reflection of light may be so translated as to become manifest to the sense of touch, thus robbing blindness of more than half its terrors?

Certain phenomena observed and recorded by Dr. J. G. Davey, of Bristol, and recorded in the "Journal of Psychological Medicine and Mental Pathology" (vii., Part 1), throw a new light upon this question, as well as upon certain allied subjects. It is now generally understood that the special senses, such as sight, are merely special developments of feeling. We find creatures utterly eyeless; others exist, again, which have very rudimentary and imperfect eyes, so that, though they are demonstrably conscious of the difference between light and darkness, they are unable to perceive objects. So far as we can judge, their outlook on the world is much the same as what we have if a piece of oiled paper or of ground glass were placed before our eyes. Such animals—*e.g.*, the Doridæ—have eyes placed beneath a skin which is not perfectly transparent, and which has no aperture. From the mere vague consciousness of light not clearly distinguishable from feeling, as met with in the lowest animals and possibly in plants, up to the distinct recognition of variously illuminated objects, as we meet with it in insects, birds, and mammals, we find a gradual chain of development. Sight is not a faculty *sui generis*, standing utterly apart, but has its root in that general sense of feeling which is distributed over the whole surface of the body. The same must be said of hearing, smell, and taste. The faculty which in its crudest state merely takes cognizance of solids becomes gradually refined, so as to be definitely affected by the undulations of the inter-molecular ether.

From this point of view we can better understand what has been called the law of "organic compensation." If one organ is weakened or destroyed, its functions are to some extent undertaken by some other organ. That, *e.g.*, blind

men become wonderfully acute in their senses of hearing and feeling has been known for thousands of years. Dr. Davey quotes, from the "Twenty-first Report of the Directors of the Hartford Asylum," the case of a girl, named Julia Brace, who had lost both sight and hearing, and whose sense of smell became wonderfully acute. "She has been frequently known to select her own clothes from a mass of dresses belonging to 140 persons. Her manner is to examine each article by feeling, but to decide upon it by the sense of smell; and in regard to her own things she is never mistaken. She has been frequently known to discriminate, merely by smelling them, the recently-washed stockings of the boys from those of the girls at the asylum." Having such facts before us, we need, be it parenthetically remarked, wonder little that an ant should distinguish strangers of the same species from its own fellow-citizens. Nor need we feel surprised that the ichneumon should become aware of the presence of a larva deeply buried in perfectly opaque matter.

But the case which Dr. Davey has to describe is of a much more remarkable character. It is not the mere increase of the acuteness of one special sense in compensation for the loss of others. The delicate sense of smell possessed by Julia Brace enabled her to distinguish objects by recognising minute shades of odour which for ordinary human beings are non-existent. But it did not undertake the direct functions of the eye or the ear. It did not, *e.g.*, enable her to read. What, however, is to be said when we find a blind and deaf woman examining a picture or a photograph with the fingers of the right hand, and then being able to give a description—often full and detailed—of its colouring and the several objects thereon? What must we think that she is communicating with "by writing with the finger on her face, which is so sensitive that it receives and transmits to the brain the slightest movements of the finger, whether moved up or down, across, or in any direction?"

The first comment made in many quarters will be a lamentation about Spiritualism, jugglery, DOMINANT IDEAS, and the like. On this hand let us first hear Dr. Davey describe his own position:—"I shall treat the subject in hand from a physiological stand-point. Of matters supernatural or forces outside Nature I know nothing. If anyone here expects me to discourse or speculate on the immaterial, the metaphysical, he will be disappointed: for this single and sufficient reason, I believe in nothing of the kind. As a materialist I hold that to degrade matter as is

now done, to regard matter as else than the mainspring,—the only direct and sufficient cause of each one and all of the vital phenomena,—else than the ever-potent force at work in and through both the organic and inorganic worlds: and as such doomed, in virtue of natural law, to realise, ever and anon, that sublime adaptation of means to the end, at once sustaining, perfecting, and all-wise: so I say to degrade matter is to stem the tide of truth, of progess, and humanity. Matter and force stand now, as they ever have done and will continue to stand, in the near relation to each other of cause and effect, and so it is they cannot be separated from each other." Surely after such a confession of faith we need not expect Dr. Davey to err in the direction of the occult and the mystical!

The woman upon whom the observations have been made is a Mrs. Croad, of Clifton; she became totally blind in 1870, deaf in 1871, and is moreover partially paralysed.

In the experiments performed, in the presence of Drs. Davey, Andrews, and Elliott, every precaution seems to have been taken. The blindness of the patient was not taken for granted, but she was thoroughly blindfolded. Although "the eyelids of Mrs. Croad have been for many years persistently closed by a spasmodic action of the muscles," a pad of cotton-wool was placed over each orbit; "the face was then covered by a large and thickly-folded neckerchief: this was tied securely at the back part of the head, and—even more than this—more cotton-wool was pushed up towards the eyes on either side of the nose. Not content, however, the aid of two fingers of a bystander were called into requisition, and with these a continued pressure was kept up outside and over the neckerchief and wool, and above the closed eyes." Moreover the room was on two occasions very thoroughly darkened. Under these circumstances the experiments were conducted, and, as far as can be judged by anyone not actually present, the results must be accepted as decisive proof that the fingers were doing duty for the eyes. On a picture card or a photograph being handed to her, she "places it on or about the chin or mouth, and perhaps draws it across the forehead, but the minute examination of the card is apparently the work of the fingers of the right hand. These several acts are, for the most part, followed by a quiet and intense thought, a well-marked concentration of mind on the picture, when, after a short time, she writes on a slate kept near her a description—sometimes a full and detailed one—of the card, its colouring, and the several objects thereon. Occasionally her rapid and precise perception—

or, if you prefer the word, conception—of the picture, and of the many, though minute and trifling, objects going to form its entirety, is really startling."

We have already mentioned the manner in which Mrs. Croad's friends communicate with her, by writing, so to speak, with the finger on her forehead. This the author does not think very remarkable, all that is requisite being a heightened sensitiveness of the nerves of the face. But her daughter communicates with her in a different manner. Miss Croad does certainly move her fingers over and about the face of her mother, but—unlike visitors and friends—forms few, if any, letters or words. "As a rule it was simply requisite that she put herself in a close or personal contact with her mother, to convey to her what was wished."

Mrs. Croad is also said—indeed Dr. Davey gives an instance from his own experience—to have the power "of detecting, as it were, by sympathy or by a community of ideas and feeling, any letter written by a friend of hers, and put into her hands by a third party." We should be rather disposed to refer this power, if it really exists, to an intensification of the sense of smell, as in the case of Julia Brace.

There are other features of the case for which Dr. Davey does not personally vouch, but which are much more inexplicable. Thus:—"It is said by those near and dear to her that such is Mrs. Croad's prevision that she has been known to have foretold my own visits to her: what I mean is, that on my approach to the house she occupies, but when still at a distance from it, and unseen by anyone about her,—in fact not within sight,—she has said 'Dr. Davey is coming; he will be here directly.'" This is, indeed, very difficult to believe, and we shall take the liberty of referring it to that great group of occurrences, real or supposed, on which we suspend judgment. The author mentions, however, that his friend Dr. Maclean had, in the earlier part of his practice, a hysterical patient who displayed "the same lucidity." "But this is clairvoyance," will be the exclamation of many, "and, if clairvoyance, delusion!" What it is to be called seems, however, to us a very subordinate question. The first consideration is, Are the details above given, of the perception of pictures and photographs with the fingers, actual facts? We must avow that we see no reason to doubt it. The woman is pronounced blind, not merely on current report, but on substantial medical authority. The precautions taken, in case she still possessed any remnant of sight, seem fully sufficient, especially if we call to mind that on two

occasions the room was darkened. The only loophole left for those who contend that Mrs. Croad and her friends are deceivers, and have succeeded in mystifying Dr. Davey and his professional friends, is the theory of collusion. Did any person present, for instance, and more especially the daughter, convey to Mrs. Croad hints as to the nature of the pictures and photographs by means of touches or pressure? It has been already stated that a peculiar "sympathy," or "community of ideas and sensations," existed between the mother and the daughter. This point has not escaped the attention of the author. He informs us that "Miss Croad stood or sat, as a very general rule, on the left of her mother and very close to her; in fact the head of Mrs. Croad reclined on the right shoulder of her daughter, to say nothing of the frequent, though temporary, contact of the fingers of Miss Croad with the cheek of her mother." Dr. Davey, therefore, very naturally asks, "In what relationship, if any, did such close and personal contact of these two persons stand to the strange perceptive power already explained with regard to the picture-cards and photographs? Was the said contact the cause or source in any degree of the lucidity or clairvoyance manifested over and over again by Mrs. Croad, and witnessed by so many?" It has been suggested that Miss Croad did, in some strange way, convey to her mother during the testing a knowledge of the cards, the objects represented on them, their colours, &c. Well, the suggestion was acted on: the same testing, on being again and again repeated, and in the absence of Miss Croad from the room occupied by her mother, proved altogether and conclusively in favour of Mrs. Croad. The same evidence of the same "transference of special sense" from the eyes to the fingers was always forthcoming.

Hence, therefore, except we are prepared to say boldly "*Tant pis pour les faits*," we must accept the phenomena as genuine, and may, if we please, pronounce them clairvoyance.

But we must now refer to the two cases where the experiments were performed, as it would appear successfully, in a darkened room. Here the eyes would evidently be at fault. Sight depends plainly on a perception of the rays of light partially absorbed by and partially reflected from the surfaces of bodies illuminated. But where there is no light, either absorbed or reflected, seeing, as we commonly understand it, can be performed neither by the eye nor by any other organ of the body acting vicariously in its stead. Two suppositions are, however, still open:—Do objects which

have been illuminated, and which in consequence of their varied colouration have been differently affected in different parts, retain for a longer or shorter time the power of acting upon a highly—we will say a morbid—sight organ? Is phosphorescence possibly a general property of matter, provided we had a sufficiently delicate test for its recognition?

Our second suggestion is, Do the phenomena above detailed prove the transference of the sense of sight from the eye to the finger-tips, or rather the development in them of a new sense not dependent on light in the ordinary sense of the term? The well-known experiment of Spallanzani on bats, which Dr. Davey quotes, as well as certain phenomena of insect life with which we have been much concerned, seem to favour this notion. The possibility of senses other than the five commonly recognised in man and the vertebrates generally cannot be rationally denied. Positive instances of their occurrence are still to seek.

Whether either of these suppositions will explain all the phenomena here noted is, however, very doubtful.

The author says, "It should be stated that at my second interview with Mrs. Croad, and in the presence of Dr. Andrews and others, certain of my own personal and private convictions on a particular subject became, as it would seem, in a strange and exceptional manner, known to Mrs. Croad. She asked me if I would allow her to tell me a secret in my own life-history, and would I be offended if she wrote it on her slate? I replied 'No.' That written on the slate was and is a fact, than which nothing could or can be more truthful and to the point. Dr. Andrews is prepared to verify this." Here all explanation in the present state of our knowledge, is wanting. We fail to see how any known—it might almost be added any conceivable—sense could enable one person to perceive the past experience of another. Many readers will at once cut the knot by a simple denial. For our part we do not feel at liberty to escape from the difficulty in this manner. We are accustomed to accept the evidence of a gentleman and scientist unless we have already found him to be a defective observer and self-deceiver, or unless his statements are mutually contradictory or opposed not to imperfect and doubtful theories, but to established facts.

We read further:—"It should be added, on the authority of Mr. Westlake, that Mrs. Croad asked his wife whether there was a room beyond (pointing where there was a passage). Being told 'Yes, two,' she said 'What does the

servant do down there at night when you are all in bed ?' She was told that the servant had no business there, and the reply was 'Well, she does go down there; I have known her do it more than once. She takes off her boots first.' It is added, 'We made inquiries, and found that when she thought we were all asleep the girl went into these rooms and helped herself,'"—little thinking that her movements would be traced by a blind and deaf woman!

It is to be deeply regretted that such statements as we find in Dr. Davey's pamphlet, instead of being carefully verified and then rationally studied, as would be the case if some novel phenomenon in inorganic nature were concerned, are contemptuously denied by some, and purposely interwoven with charlatanism by others.

ANALYSES OF BOOKS.

Butterflies, their Structure, Changes, and Life-Histories, with Special Reference to American Forms. Being an Application of the "Doctrine of Descent" to the Study of Butterflies. With an Appendix of Practical Instructions. By SAMUEL H. SCUDDER. New York: Henry Holt and Co.

THIS fascinating volume opens with a curious fact. "A box of butterflies hanging on the wall of a fellow-student's room in college first introduced the author to the enjoyments of a naturalist's life." Mr. Scudder begins his task with an account of the structure of the eggs of butterflies, and of the internal changes which take place during the development of the larva, as far as is yet known. On this subject much work is still required. The question further suggests itself, To what extent do the forms and the tracery of these eggs—many of which are here beautifully figured—exhibit relations in closely-allied species and characteristic differences in distinct groups? Are the peculiarities of the egg in any way adapted to the circumstances in which it is placed?

Coming to the caterpillar, we find a careful and well-illustrated account of its general structure. In figure 21, representing the head of the caterpillar of *Danais Plexippus*, we note an oversight in the lettering: *a* evidently is a side, and *b* the front view of the head. The author points out in caterpillars two foreshadowings of the future state of the insect, or, to speak more precisely, two structural peculiarities which have no immediate purpose. Thus the spiracles are absent from certain of the median segments of the body. The only reason we can see for this arrangement is, that in the perfect insect spiracles in this region would interfere with the support of the wings and the apparatus for their movement. Even in the disposition of the spines along the back we have a pre-indication of the future separation of the thorax and abdomen.

Not all entomologists are aware that the vesicles of the seventh segment of the caterpillars of many of the "blues" secrete a fluid very grateful to ants, which, in consequence, instead of devouring the caterpillar, carefully defend it from the attacks of ichneumons.

The author calls special attention to a question which, if old, is by no means thoroughly settled: Why do butterflies deposit their eggs upon the kind of plant suitable for the nourishment of the young? He writes—"Let us take, for instance, the viceroy

(*Basilarchia Archippus*), which during the butterfly life has never tasted, can by no possibility ever taste, of willow or poplar; that it should choose just those trees necessary for the food of progeny it is never to see defies our powers of explanation on any hypothesis which leaves all to blind forces." Though by no means pledged to any such hypothesis, we think the difficulties of the case scarcely so great as the learned author represents. Granting that the mature butterfly has never tasted willow or poplar leaves, why should we assume that it has forgotten the diet of its earlier stages from which all its tissues have been elaborated? Is it not quite conceivable that, by the smell of such trees, the female may be stimulated to oviposition? If we pronounce this and similar phenomena to be the results of a Divinely implanted "instinct," we have to face the difficulty that such instincts mislead, as in the case of the blowfly, who deposits her eggs not upon carrion, but upon flowers with a carrion-like odour, where the larvæ of course perish.

Referring to the fact that the young caterpillar, immediately after emerging from the egg, devours the shell, the author pronounces this act "plainly a provision of Nature, by which the tender animal is rid of a sure token to his enemies of his immediate proximity. Is this reason or instinct? and, if instinct, will those who believe this power to be only an accumulated inheritance of ancestral wisdom pray give us a single suggestion of the line of descent by which this lonely, defenceless creature learned his art?" We are reluctant to differ from a naturalist of Mr. Scudder's eminent merit, but to us the whole transaction appears in another light. We do not see that the egg-shell is devoured as a precaution against enemies. Suppose an insectivorous bird finds the empty shell of a butterfly's egg upon a leaf. How is he to know whether the inmate escaped to-day or yesterday, whither it has wandered, whether or no it has already fallen a victim to some other bird, or whether the larva has emerged in due course, or the shell has been broken and its contents devoured by some predatory insect? We suspect that this habit of the young caterpillar is an instance of that preference for animal food which most creatures show in the earliest stages of their existence.

Hurrying over a great extent of important matter, we come to a chapter on the "Origin and Development of Ornamentation." It is very justly remarked that in the butterflies—and probably in them alone—there is a direct relation between beauty and rank, the most variegated and exquisite patterns being found in the higher families. This, the author adds, is what should be expected on the theory that the lower represent earlier, and the higher forms later, developed from the common stock. He points out the wide difference between the ornamentation of vertebrate animals and that of butterflies. The former is the result of a series of protracted changes, extending over months of the animal's life. In butterflies the wing-scales are found at once

during the pupa state, and when the insect is as far withdrawn as possible from external influences. Still he thinks that in the two groups the phenomena do not originate in distinct proximate causes, and that among vertebrates, as among insects, "we shall be forced to discard the idea of direct physical causation." This is substantially an admission that the laws of the production and distribution of colour in animals are beyond the reach of man's intelligence.

He points out several objections to the theory of the Rev. H. Higgins, who maintains that the dark spots are chiefly seated on the wings in consequence of the greater facilities there for the deposition of colouring-matter. Mr. Scudder shows that, on the contrary, in the body of the wing the coloured spots are invariably placed in the interspaces between the longitudinal veins.

The author's own hypothesis is that "the wings of butterflies first showed signs of divergence from uniformity by a deepening of the colour next the outer margin, which thereafter became separated into distinct transverse bands: these bands in breaking up gave rise to dark-veined or to spotted wings, which served as the basis for all the variegated patterns of the present day, including ocelli, which are only specialised forms of simple interspacial spots."

It has always seemed to us that the intensification of colour along the margins of the wings, or of certain portions of the wings, is connected with capillary attraction. With the author's observation that "to a certain extent there is a polar distribution of markings" we fully agree. Mr. Scudder does not appear to lay much emphasis upon "sexual selection" as a cause of the varied tints and patterns in butterflies. Nor is he an unlimited believer in the doctrine of protective colouration. He asks, "Can such a play of plan in ornamentation be explained as purely for the purposes of the ephemeral creature itself? If it cannot,—if, for instance, it is of no advantage to the butterfly that its second brilliant ocellus should occur in the area of the first rather than of the second vein,—then it cannot have arisen through natural selection without the guidance of a higher law, which has other ends for beauty than the mere survival of the creature possessing it."

In the chapter on "Ancestry and Classification" we find the following significant passage:—"That the groupings and relations of structure among animals are clear to the human mind,—that they present an orderly arrangement and a harmonious inter-combination which appeals to his reason,—is sufficient proof that natural selection, in all its wondrous and pervading power, acts under law, a law of Evolution which is no slave to the forces of Nature, but brings them into subservience to its ends; a law which is working out the plans of a Supreme Intelligence by ways which man may apprehend, but has not yet comprehended."

We regret that we must here bring our survey of this work to

an abrupt end. An entire number of the "Journal of Science" would not suffice for the worthy exposition and discussion of its views. We can only hope that the specimens we have given will lead our readers to study it for themselves.

Annual Report of the Board of Regents of the Smithsonian Institution for the Year 1879. Washington: Government Printing-Office.

THIS report presents, as usual, an assortment of matter, some of it of very general and permanent importance, whilst others refer merely to the working details, the financial condition, &c., of the Institution.

A biographical notice of James Smithson, the founder, and of his bequest, conveys the information that he—contrary to the general belief—had not been during his life specially connected with the United States. "He is not known to have had a single correspondent in America, and in none of his papers is found any reference to it or its distinguished men." But we cannot regret that this illustrious Englishman should have selected the American nation for the trustees of his magnificent endowment. Had he bequeathed his fortune to be employed in England, "for the increase and diffusion of knowledge among men," it is easy to guess what would have been its destiny. As it was, some discussion ensued concerning the acceptance of the bequest. Some maintained that Smithson intended to found a university. The "men of words" felt an especial longing to have the control of these funds. F. Wayland, President of Brown University, proposed a university to teach Latin, Greek, Hebrew, Oriental languages, rhetoric, poetry, the law of nations, &c. The proposal to devote the money to the formation of a great national library seemed at one time likely to carry the day. It was even urged that the bequest had better be sent back to England and returned to any heirs of the donor who could be discovered. It was not, in short, until after long and acrimonious discussions—in which one of the representatives asked, "How did it happen that this Government accepted such a boon from a foreigner, an Englishman too?"—that the constitution of the Smithsonian Institution was settled in its present form.

A large part of the present volume is taken up with an illustrated memoir of the Savage weapons displayed at the Philadelphia Exhibition, 1876.

The succeeding papers are on the "Antiquities and National Monuments of Denmark," and on the "French Half-breeds of the North-west." Contrary to what is often asserted concerning mixed races, we are told—"They are not stronger than the

whites, and for a short time perhaps capable of less powerful exertion, but they possess extraordinary powers of endurance, and in the long run would easily outstrip the whites." They are likewise, in opposition to another current nation, decidedly prolific, and have large families.

A number of papers, running to more than a hundred pages, attest the great interest now taken in America in the ethnology, antiquities, and history of the Aborigines,—if so we may call them.

We come next to a memoir on the "Present Fundamental Conceptions of Physics," the substance of two lectures delivered in Vienna by Prof. F. J. Pisko.

Light and Heat. The Manifestations to our Senses of the Two Opposite Forces of Attraction and Repulsion in Nature. By Capt. W. Sedgwick, R.E. London: C. F. Hodgson and Son.

We can do little more at present than briefly indicate the principal points brought forward in this pamphlet. The author considers light, the attractive force, as identical with gravity. He meets the objection that upon this hypothesis gravity would be greater by day than in the night, by arguing that "with daylight comes day-heat, and heat is directly opposed to gravity." He further suggests that if we were provided with a more delicate means of measuring the force of gravity, there would be found a diurnal variation in its intensity. Heat is not identical with light, but its antagonist.

The fundamental phenomenon from which he starts is the spot of light observed on going into a dark room, and applying pressure to the eye ball with the tip of the finger, preferably between the pupil and the nose. This spot consists of a small bright nucleus, surrounded by a number of rings alternately bright and dark, the outermost being very faint, and "the middle ring vividly bright when the pressure is first applied." If pressure is applied to the eye-ball in bright sunlight, the result is merely a dark spot with a faintly luminous border.

A second experiment is as follows:—A piece of well-crumpled silver or tin-foil is laid horizontally in the full sunlight; the eye is then brought to within an inch of it, but in such a manner that the head does not shade off the sun's rays from the foil. The patches of light upon the foil revolve themselves into round spots, all alike in form, size, and general appearance, and each with five bright lines radiating from the centre. A similar spot with five radiating lines is seen if we look at a source of light

through a minute hole pierced in cardboard. Hence he concludes that each such spot represents the effect produced upon the retina of the eye by the incidence of a single separate ray of light. He thinks that the effect produced by pressure on the outside of the eye-ball can only be obtained from within by a pull, and that when a single ray of light passes into the eye it makes itself manifest to our vision by exerting a pull upon the retina of the eye. Hence light is a pulling or attractive force, opposed to heat as a pushing or repulsive force.

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*The Boundaries of Religious Liberty and the Science-Doctrine of Modern Exploration of Nature.** By GUSTAV FRIEDRICH. Leipzig; Siegismund and Volkening.

LET us confess it; we were somewhat led astray by the title of this little book. We expected an examination of the debateable land which lies between the borders of Religion and Science, and perhaps the suggestion of a *modus vivendi* which might put an end to certain unseemly and unedifying disputes. We find a discussion on the light which the modern classification and philosophy of Science has to throw upon the limits of religious freedom. It is obvious that into such questions as the modification or strict execution of the "May laws" we cannot for a moment enter.

But the author's views on the classification and the doctrine of the Sciences admit of being considered in our pages. "The Sciences," he writes, "spring from the experience of daily life. Between that which they teach us concerning the nature of things and that which we experience in common life by our own contemplation there is no specific difference. The Sciences are, so to speak, merely a higher power (*potenz*) of common sense." He establishes three classes—the experimental, the descriptive, and the spiritual (mental or moral) Sciences, concerned with law, politics, art, religion, history, &c. He forgets that as the boundary between experiment and observation is not of a hard-and-fast nature, so the sciences based on these two great methods of research cannot well be treated as decidedly distinct classes. His judgment on those who do not accept this dualism is sufficiently severe. In illustration of his way of thinking we quote from a Note on the Bibliography of Scientific Methodology the following:—"Herbert Spencer's 'Essay on the Classification of

* Die Grenzen der Religions freiheit und die Wissenschaftslehre der heutigen Naturforschung.

the Sciences, from which we might have expected something, is worthless. He does not even recognise the difference between the Natural and the Moral Sciences, without mentioning that of the two subdivisions of the former. He divides the Sciences into concrete, abstract, and abstract-concrete, without imagining that the forms of the knowledge stored up in them are perfectly indifferent for its trustworthiness and value. Still more deplorable is Boens, 'La Science et la Philosophie, ou Nouvelle Classification des Science.' He arranges the Sciences according to the ideas, substance, quality, and relation, and vaunts this as the basis of the clasification of Comte the Positivist. It is curious what is put forward under the garb of Positivism! We naturally find Comte's fundamental error not here, but in his total ignorance of the gulf between the natural and the moral sciences, so that he could consider a *physique sociale* as possible."

This passage is the more remarkable as certain thinkers, entitled to consideration, hold that Comte's chief merit lies in his ignoring the alleged distinction between the "natural" and the "moral" disciplines, and proclaimed the unity of all Science. Our author holds that whilst physical science attains certainties in the shape of laws, the moral sciences cannot rise higher than rules which are defended the more vehemently the more doubtful their formation. The application of these considerations to the question of religious toleration is easy to be seen. That much of what is said bears the mark of great ability cannot be denied. But we could not enter upon its exposition without transgressing the boundaries of our jurisdiction.

Conic Sections treated Geometrically. By S. Holker Haslam, B.A., and Joseph Edwards, B.A. London: Longmans and Co.

The object of the authors is to furnish a concise and uniform method of treating geometrical conics. They define conics as *plane loci*, deducing their general properties from this definition by means of the so-called "auxiliary circle of a point." This construction shows clearly the relation which the three species of conics bear to each other and to the circle. It leads to a method of plane projection, which the authors consider as more powerful than conical projection, and which they name "focal projection."

Roorkee Hydraulic Experiments. By Capt. ALLAN CUNNINGHAM, R.E. Vol. I., Text; Vol. II., Tables; Vol. III., Plates. Roorkee: Thomason College Press.

THE rate at which water is discharged through channels, natural or artificial, is a matter of no small practical importance; yet, strange to say, it has been so little the subject of thorough-going investigation that engineers of well-known ability differ widely from each other if called in to determine the average flow of water passing along a stream or a drain. Instances of such discrepancy have frequently occurred to us when experimenting on the chemical treatment of sewage. Having ascertained the working formula for say 100 gallons, came the question what is the average fair-weather flow from the town concerned; and here the results have varied widely. The flow from one town has been stated to us at every figure from 8 to 14 million gallons daily.

The author finds that experiments on large rivers can seldom be executed with the precision necessary for discovering the general laws of fluid motion. Operations on a very small scale, on the other hand, give results not trustworthy if applied to larger bodies of water. The best opportunity for a fundamental study of the question is afforded by large canals,—such as the irrigation channels of India,—where large volumes of water are in uniform motion in regular channels.

The chief objects of the experiments conducted by Captain Cunningham and his assistants were the discovery of a good method of discharge measurement, an investigation of the applicability of known formulæ for mean velocity, and the discovery of a good approximation to mean velocity.

The chief results reached are that loaded tube-rods give a rapid and sufficiently close approach to mean velocity past a vertical. The author considers that for depths not exceeding 15 feet they should supersede all other instruments. Rods made of tin tubing were found preferable to all others; they require to be as thin as is consistent with rigidity, with a smooth surface. The centre of gravity should be as low as possible in the water, and the convex surface smooth throughout.

Capt. Cunningham finds that discharge-measurements, when carefully executed on his system, do not vary respectively more than 3 per cent. This conclusion is based upon a careful comparison of repeated measurements, and must be pronounced satisfactory.

As regards the existing formulæ for mean velocity, none of them seems generally applicable. That of Kutter, which is the most general, gives an approximation much below the results of direct measurement. This conclusion the author admits as disappointing, especially as he is not able to propose a preferable

formula. The best means of rapid approximation to mean sectional velocity he considers to be the measurement of central mean velocity. The reduction, however, must be accomplished by means of special experiment at each locality.

Among the minor results must rank the observation that "the motion of water in large open channels is essentially unsteady; even in long, straight, and fairly uniform reaches the velocity at any given point is extremely variable from instant to instant, and the stream lines interlace freely in all directions." The maximum velocity past any vertical is, as a rule, below the surface. To measure mean velocity past a vertical the immersed length of such rods must be decidedly less than the depth of the water.

That this work is a valuable contribution to hydraulic science, and that it will repay engineers for a careful study, is our decided opinion.

The Phenomena of the Electric Discharge with 14,400 *Chloride of Silver Cells.* A Discourse by Dr. W. De la Rue, F.R.S., delivered before the Royal Institution.

The battery used in the author's experiments, but a solid electrolyte, silver chloride, is substituted for the sulphate of copper solution. It is impossible to give an abstract of the subject matter without the very numerous illustrations contained in the pamphlet.

Solutions of the Questions in Magnetism and Electricity set at the Preliminary Scientific First B.Sc. Examinations of the University of London from 1860 *to* 1879. Together with Definitions, Dimensions of Units, Miscellaneous Examples, &c. By F. W. Levander, F.R.A.S. London: H. K. Lewis.

Whatever the excellence of this work in other respects, we cannot do other than characterise it as the outcome of a radically vicious system,—that, namely, which makes it the student's great task not to acquire a thorough mastery of his subject with a view to becoming himself a successful interrogator of Nature, but to prepare for passing examinations. We cannot blame Mr. Levander, connected as he is with University College, and consequently with so purely an examinational body as the University of London, for adapting himself to existing circumstances; but

we deeply regret the system which compels men of learning and ability to turn their attention in this direction.

A list of the questions which have been put to candidates at examinations for the last twenty years will of course give the student a very fair notion of the ordeal awaiting himself. We have met with "superior" men who, whilst believing in and defending examinationism, denounce books such as the one before us as "instructions how to cheat the examiner." We cannot accept such a view. If the said "superior" men really wish for realities in place of shams, let them give degrees of B.Sc., D.Sc., &c., to those who have proved themselves capable of research, and to none others. In the meantime everything that tends to make the farcical character of examinationism more manifest has our best wishes.

A Dictionary of Chemistry and the Allied Branches of other Sciences. By HENRY WATTS, B.A, F.R.S., F.C.S. Assisted by Eminent Contributors. Third Supplement. Part II. London: Longmans and Co.

MR. WATTS and his learned coadjutors are ably and laboriously pursuing a task which reminds us of the much-quoted stone of Sisyphus. As fast as they approach completion new discoveries are brought forward, and require extensions and modifications of what has been already written. The dictionary form which the author has adopted is the only one at all suitable for a science in a state of such rapid growth and transition.

The volume before us completes the record of chemical research as far as the end of 1878, and embodies the more important discoveries which have appeared in 1879 and 1880.

That the editor has executed his difficult task most satisfactorily might have been inferred from the former volumes, even if we had not convinced ourselves by careful examination that such is the case.

Among the more prominent and valuable articles we must call especial attention to that on Heat, which includes the recent important development of what is called thermo-chemistry. The determinations of the heats of chemical combination, of chemical action, of solution as determined by Berthelot, Thomsen, Troost, Hautefeuille, &c., are given at great extent, and the signification of these researches for chemical theory is pointed out. The latest results in thermolysis, or dissociation, are embodied in the same article.

The article on Spectral Analysis is from the pen of Dr. A. Schuster, a physicist who has made this department peculiarly

his own. The latest results of Mr. Norman Lockyer in solar and stellar spectroscopy are stated and discussed. As regards absorption-spectra the author reminds his readers how these are affected by the solvent used, by the degree of concentration, and even by the presence of other bodies, and consequently what great care is needed in employing the spectroscope in analysis.

The article on Light summarises much new and valuable matter, especially as regards circular polarisation. The chemical action of light, especially upon organic matter,—*e.g.*, chlorophyll,—is very far from being fully understood. Thus Pfeffer finds that the decomposition of carbonic acid by plants is most active in the yellow, and descends regularly on either hand from that point. On the other hand, Timinaseff observed the maximum decomposition in the red, corresponding with the characteristic absorption-band of chlorophyll. The blue and violet rays, though absorbed by chlorophyll, are found to have no effect upon the absorptive power of plants.

The article on Volcanic Products is exceedingly interesting. It appears that of the fifteen non-metallic elements twelve, and of the fifty-one metals nineteen, have been found in volcanic products. It is exceedingly probable that others will be detected on careful examination. We can, *e.g.*, scarcely imagine nickel to be generally absent where cobalt is present. Seeing that iodides have been detected, bromides, as the author remarks, will scarcely be absent. The complexity of some volcanic minerals is remarkable. Thus a spongy and crystalline mass from the crater of the island Vulcano contained arsenious and selenium sulphides, boric acid, ammonium chloride, lithium sulphate, and the alums of thallium, cæsium, rubidium, and potassium.

Besides the above-mentioned, and not a few other extensive articles, the work contains notices of numbers of minerals, organic principles, and artificial products, which have either been recently discovered or more thoroughly examined since the appearance of the last Supplement.

We are not aware of any work of reference in any language, covering the whole extent of chemical and chemico-physical science, which can be placed on a level with Mr. Watts's "Dictionary."

CORRESPONDENCE.

, The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

THE HISTORY OF MUSCLE-READING.

To the Editor of the Journal of Science.

SIR,—Mr. Irving Bishop recently called upon me, while I was in London, and stated that from his childhood he had been accustomed to indulge in one of the modes of muscle- or body-reading; that he had been wont to say so before his European audiences; and that the extract from my letter in your issue in July, to the effect that he had learned what he knew of it from my investigations of "Brown the mind-reader," were inconsistent with the statements he had been making.

In the paper on the "Physiology of Mind-Reading" which you published I stated at the outset that the trick had been known for a long time, and had been performed by different persons in different countries in different ways. It is not improbable, certainly not impossible, that Mr. Bishop may have known of some of these methods before Brown the mind-reader swept across the American continent, carrying everything before him by his brilliant, and up to that time publicly unheard-of, demonstrations. The possibility that Mr. Bishop may have known some one of these methods before Brown's public appearance may therefore be conceded.

The facts, however, are demonstrable that my exposure of Brown the mind-reader directed the attention of Mr. Bishop, as well as all others, to what before was scarcely known at all, even in limited circles; and that after the publication of my researches, which made great excitement in America at the time, Mr. Bishop saw me in regard to them, and did not accept the explanation I had demonstrated. The method of mind-reading by the ear, *without contact*, subject and operator walking near together, the operator judging by the step of the subject, which Mr. Bishop now performs, was fully described in the supplementary letter of my article, which has not been published this side the Atlantic. This interesting phase of mind-reading was developed originally

by a scientific man in America, entirely independently of my own researches.

Mr. Bishop is a professional sleight-of-hand performer, and is not bound to reveal whence he gained all his secrets, and my reference to him was incidental only. He has given the psychologists of England opportunity to investigate the phenomena of muscle-reading fairly and fully, as I understand, and for this he is to be credited and Science to be congratulated, for the phenomena are most remarkable indeed. I am glad to have my own researches confirmed here, as they had long ago been many times confirmed in the States; and it is very interesting to note that Mr. Geo. J. Romanes, William Croom Robertson, and others who have studied the subject in England, have, so far as they have gone, passed step by step through the same stages of doubt and difficulty, and demonstration, that I passed through with my experiments. It is to be regretted that other psychologists whose attention was called to this matter did not also improve this most excellent opportunity to study the action of mind on body. Ten years ago there was not a physiologist or psychologist in the world who would have admitted the possibility of these phenomena; now there is no one who has seen and studied them who will deny their genuineness.

The chief criticism I have to make is on the conduct of Dr. W. B. Carpenter, and in this criticism all who know the facts must be in accord. When Mr. Bishop first came to Dr. Carpenter, the latter surely could not have forgotten that my original paper, "Muscle-Reading *versus* Mind-Reading," had not only been long in his possession, but quotations from it had been made by him in his own writing. He could not have forgotten that a year or more before he had written me in regard to that subject, and that very paper saying that he was so much pleased with that paper, as well as with another monograph of mine in which I had formulated the six sources of error in experimenting with human beings, that he had desired me to send him, as speedily as possible, all my papers on Trance, the Involuntary Life, and allied themes, in order to assist him in the paper he was preparing for publication. He could not have forgotten that in that same letter he stated that these subjects had occupied his mind for forty years, but that I had been able to give them more exclusive and successful attention than had been possible for himself. He could not have forgotten that he also spoke of Mr. Bishop, and some of the phenomena produced by him that he and Prof. Huxley had witnessed. The reprints and monographs that he desired, including the Physiology of mind-reading,—which you published, were promptly sent to him with an accompanying letter.

The next heard of the subject in England is a letter from Dr. Carpenter introducing Mr. Bishop to the scientific world as possessing some novel powers, and giving an implied—though

not absolutely stated—indorsement of Mr. Bishop as a mind-reader, or at least leaving the question an open one. It is certain that the majority, if not all, of those who received a copy of the letter were led to believe that the claim of mind-reading was to be established, and there was great disappointment on finding Dr. Carpenter's letter had given an erroneous impression; and from this disappointment there resulted an indifference to the solid and important basis of fact that existed in those experiments.

The true course for Dr. Carpenter was very simple. He should have stated in clear language that Mr. Bishop was not a mind-reader, as he claimed, but a body- or muscle-reader, but that his muscle- or body-reading, though not new to Science, since it had been exhaustibly studied years before by Dr. Beard, with whom he had communicated on the subject, was yet of the highest interest to students of this side of psychology.

For myself personally there is no cause for complaint, since the priority in absolutely demonstrating the philosophy of muscle- and body-reading has been conceded to me without dispute in America and in Europe; but I fear lest scientific men whose taste would lead them to studies of this kind have been so far repelled by this one false claim that they may be tempted to neglect not only this special phenomenon of muscle-reading, but all the other phenomena of trance and the involuntary life with which are interwoven the profoundest problems of the century.

To my own mind the subject is more interesting after it is explained than before. In the accounts of the early English experiments that crossed the Atlantic the name of Prof. Huxley was used as a quasi-endorser of Mr. Bishop; but a letter from Prof. Huxley, that reached me before I left New York, made it quite clear that his name had been used without authority.—I am, &c.,

GEO. M. BEARD.

London, August 17, 1881.

PS.—The term "muscle-reading," coined by me on the first publication of my experiments, may perhaps be replaced by body-reading, since the phenomena are produced not by any one muscle or by any limited groups of muscles, but by the body or a part of the body acting as a whole. A certain fineness and mobility of organisation is essential to the highest success in these experiments; but in a degree we are all muscle-readers, and the number of good performers in America is very large. Brown the mind-reader was especially remarkable for the rapidity and precision of his performances, although, like all of his class, he met with very many failures, and with some persons failed utterly.

"JUMPERS" IN SOUTH AFRICA.

To the Editor of the Journal of Science.

SIR,—I was much pleased with the articles in the "Journal of Science," by Dr. G. M. Beard, on the "Jumpers" of Maine. The same phenomena were observed here amongst a set of farmers living about the Divisions of Richmond and Graaf Reinet, in this colony.

The first one I met with was a young man of about twenty years; he was then (about the year 1837) on a visit to Stellenbosch, when all the different tricks mentioned by Dr. Beard were played upon him. His rapid repetition of short sentences, when startled, was most remarkable and quite uncontrollable by his will. In more than one instance he would utter a whole sentence even before the last part had been expressed (?), which often annoyed him very particularly when he found that he had made use of words which were not fit to be expressed in company of ladies. He knew what was coming, but could not help himself. This young man was a Liebenberg, and the disease was principally noticed in that family.

A couple of years after that I again came across an old man, a Mr. Charles Liebenberg, who was subject to the same disease, as also three of his sons-in-law, named Pienaar.

Not many years ago, whilst living at Worcester (South Africa), I became acquainted with another person of the same stamp, Mr. Conradie, a resident of Graaf Reinet, who, as far as I am aware, is still alive. He would throw, strike, jump, &c., repeating the word also at the same time, whatever he was ordered to do when startled. I was present one day when some of these tricks were played on him, when he gave a young lady who was standing close to him such a violent blow as to send her spinning to the ground. He answered completely to the description given by Dr. Beard ("Journal of Science," 1881, p. 87).

None of these men were deficient in intellect; the one last named is a decent, well-to-do farmer. Two of the Pienaars were, moveover, brave men. They were all very ticklish, and sometimes it was only necessary to point with the finger at them and mention a word. Both Conradie and the Pienaars are of French descent.—I am, &c.,

J. W. HUGO,
Civil Commissioner and Resident Magistrate,
Clanwilliam, South Africa.

COALESCENCE OF BRANCHES.

To the Editor of the Journal of Science.

Sir,—Permit me to inform you of an instance where two distinct stems of a tree have come together and united into one without the intervention of man. If any one leaves the Chingford Branch of the Great Eastern Railway at Wood Street Station, makes for Chestnut Walk, and takes the first turn leading to Epping Forest, he will find, keeping to the left, the remains of a tall straggling hedge. Two stems of the hawthorn, which rise separately from the ground and remain distinct to the height of about 3 feet, coalesce completely into one.—I am, &c.,

An Epping Forester.

INFANTICIDE AMONG ANIMALS.

To the Editor of the Journal of Science.

Sir,—With reference to the Duke of Argyll's statement that infanticide is a point in which man differs unfavourably from the lower animals, allow me to mention, in addition to the facts given by your correspondents on pp. 367 and 432, that the domestic drake very frequently destroys ducklings by a blow at the back of the neck. I knew an instance of a drake belonging to Mr. W. Clarke, of Whirlow, near Sheffield, which was very much given to this offence, and has been seen in the very act.—I am, &c.,

A New Subscriber.

NOTES.

THE "Morality of the Medical Profession" has been made the subject of an objectionable article in the "Modern Review." In reply have appeared a letter from "Two of the Profession"—both, forsooth, anti-vivisectionists—and a protest from one whom the "Medical Press and Circular" pronounces "a scientific *savant*, one holding an unassailable position in the social world, and a highly esteemed gentleman!" We do not agree with the writer as to the policy of ignoring attacks. The tactics of social and political agitators consist mainly in throwing dirt, in the hope that some of it will stick. The persistent abuse levelled at the medical profession is part and parcel of a widespread anti-scientific movement.

Prof. Hutchinson, in his Lectures on the Laws of Heredity ("Medical Press and Circular"), mentions a very interesting fact ascertained in Berlin. Among Catholics, who prohibit consanguineous marriages, the proportion of deaf-mutes is 1 in 3000; among Protestants, who view such marriages as permissible, the ratio is 1 in 2000; whilst among Jews, who encourage intermarriage with blood-relations, the deaf-mutes are as 1 in 400.

Mr. J. T. Humphreys ("American Naturalist") records a case of a king-snake (*Ophibolus Savi*) killing and devouring a full-grown water-mocassin (*Ancistrodon piscivorus*).

Mr. A. E. Bush, of San José (in the same journal), describes the butterfly trees of Monterry (*Pinus insignis*). Three of these trees, each about 18 inches in diameter, were completely covered with live butterflies.

On June 2nd, according to the same journal, thousands of white butterflies (*Pieris monusta*) passed from west to east over certain districts of South Carolina.

Arthur de Noé Walker, M.D., one of the few medical men who deem it consistent with their duty to Science to identify themselves with the anti-vivisection hubbub, has sent round a circular denouncing the "Lancet" for its recent strictures on Homœopathy.

Prof. B. Pierce maintains that the discovery of Neptune was "only a happy accident;" the planet found by Galli, in accordance with Leverrier's directions, was *not* the planet "to which geometrical analysis had directed the telescope."—*Science*.

Trichinosis is still exciting much attention in both continents. However, the alarm is not sufficient to lead a certain part of the public to abandon the practice of eating raw and semi-raw meat.

With reference to Dr. Clèvenger's note on the close connection of the primitive desires ("Science," January 15, 1881) we learn that "mulieres in coitu nonnunquam genas cervicemque maris mordent."

Prof. Cope ("American Naturalist") points out that the mammalian types with reduced digits are dwellers on dry ground, whilst those with more numerous digits inhabit swamp and mud.

Dr. F. L. Oswald, writing on "Physical Education," in the "Popular Science Monthly," makes a powerful onslaught upon asceticism.

Dr. Dyce Duckworth ("Practitioner") enlarges on the "Insufficient Use of Milk." He says "It seems certain that our farmers can no longer grow cereals so as to make them a source of profit." For a conclusive reply to this assertion we may refer him to Mr. Prout's recent pamphlet.

We learn that mosquitoes occur in the Loffoden Islands,—bare, rocky, constantly swept by the wind, and free from marshes and jungles. What can be their alleged sanitary function there?

According to the "Scientific American" a curious observation has been made by Dr. Moritz Benedict, of Vienna. He published a book about a year ago, "Anatomische Studien an Verbrechergehirnen," in which he states that in nearly one-half of the brains of persistent criminals the superior frontal convolution is not continuous, but is divided into four sub-convolutions, analogous to the disposition of the parts found in predatory animals. In a recent paper ("Centralblatt für Med. Wiss.," November 13, 1880) he argues that much of moral perversity may and must be the result of this deflection of the cerebral organs from the normal type, producing, as it necessarily would, other arrangements of cerebral nutrition and hæmostatic relations. It cannot be fortuitous that the mental characteristics of the most perverse criminals, and also the cerebral anatomy, both resemble those of wild beasts: this double analogy must be one of cause and effect.

[If the persistent, hereditary criminal is thus marked out by a peculiar central conformation, the prospects of his reclamation must surely be very slender.]

The "Königsberger Land-u. forst. Zeitung." reports that cases of hermaphrodism are frequent in fish, especially in the sturgeon.

Principal J. W. Dawson, in a Lecture on the "Relations of Natural Science to Monistic and Agnostic Speculations," reported in the "Philadelphia Times," discussed the three theories

of Herbert Spencer as to the origin of things self-existing, or self-created, or created by external agency, and raised a laugh by saying that the possibility of creation of an agency within had never occurred to Mr. Spencer.

Dr. Dolan, writing in the "Medical Press and Circular," proposes some much-needed restrictions on dogs and dog-fanciers.

Dr. W. B. Carpenter, in his pamphlet on Vaccination, delivers himself into the hands of his opponents. He asks, "Do we abstain from drinking water because it is sometimes poisoned by lead?" forgetting that the presence of lead in water can be readily detected.

It is said that Prof. Huxley is a candidate for the Linacre Chair of Physiology at Oxford, vacant by the death of Prof. Rolleston.

According to a paper read before the Geographical Society of France, the Hoang-Ham—a strychnaceous plant, found in Tonquin—has been used with success as a remedy for the bite of the cobra.

The ink of the Cephalopoda when purified contains, according to M. P. Girod ("Comptes Rendus"):—

Carbon	53·60
Hydrogen	4·04
Nitrogen	8·80
Oxygen	33·56
	100·00

M. A. Brongniart has laid before the Academy of Sciences an account of the egg-cases of the *Mantis*, of the hatching, and the first moulting of the larvæ. His observations have been made in Algeria.

It is rumoured that Prof. Riley is likely to be reinstated as Entomologist to the American Department of Agriculture.

The "North American Review" has a paper by Prof. E. S. Morse, on "Prehistoric Man in America." It is an admirable summary of the present state of knowledge as regards the early history of our race.

Prof. Marsh, in an "Address on the History and Methods of Palæontological Discovery," remarks, very justly, that if Cuvier had "had before him the disconnected fragments of an Eocene tillodont, he would have referred the molars to one of his pachyderms, the incisors to a rodent, and the claw-bone to a carnivore.

"Harper's Monthly," in reviewing "Mivart on the Cat," declares that a belief in Evolution, far from leading to a denial of "Creation," distinctly affirms it, and that a candid study of

organic life makes evident the logical need for the Theistic conception.

M. Pasternatzks has investigated the seat of cortical epilepsy and of hallucinations. He finds that the attack of epilepsy induced in the dog by the essence of absinthe depends on certain parts of the grey matter of the cerebral hemispheres, and is consequently true cortical epilepsy. The hallucinations observed in the author's experiments are probably due to the exciting action of absinthe on the subcortical sensitive centres.—*Comptes Rendus.*

According to M. Arsonval ("Comptes Rendus") eggs during the first days of incubation absorb much heat. This process is accompanied by an absorption of oxygen and an abundant liberation of carbonic acid. During sleep animals absorb much oxygen and evolve little heat, the emission of carbonic acid varying little. Animals are not merely the seat of oxidations and combustions. Every living being is at the same time a reducing apparatus which effects syntheses.

We learn that a medical branch of the "Malthusian League" has been formed in this country.

Sir James Paget, in his Presidential Address at the Medical Congress, said—"It would be difficult to think of anything that seemed less likely to acquire practical utility than those researches of the few naturalists who, from Leeuwenhoeck to Ehrenberg, studied the most minute of living things, the Vibrionidæ. Men boasting themselves as practical might ask, 'What good can come of it?' Time and scientific industry have answered, 'This good: those researches have given a more true form to one of the most important practical doctrines of organic chemistry; they have introduced a great beneficial change in the most practical part of surgery; they are leading to one as great in the practice of medicine; they concern the highest interests of agriculture, and their power is not yet exhausted.'"

The following specimen of Science for the million is taken *verbatim et literatim* from the "Family Herald" of August:—"Mr. Wallace says that the butterfly is unknown in South America, the West Indies—except as a rare straggler in Cuba—and the Pacific Islands."

We learn that some 130 of the members of the Medical Congress were adroitly taken to the Croydon Sewage Farm, and regaled at a lunch the ingredients of which—as they were duly informed by Dr. A. Carpenter—were "transformed sewage." Who guarantees the completeness of the "transformation?"

According to the "Siècle Medicale" a man desirous of killing himself hammered a dagger, 10 centimetres in length, into his head up to the hilt. No unusual sensations being produced, a

doctor was sent for, in whose presence the blade was extracted by mechanical force. No pain was still experienced, but lest unforeseen complications should set in he was sent to a hospital, where he remained in perfect health for a week, and was then sent home.

The following are examination questions which are said to have been proposed by a "Congress of Domestic Economists":—

"Do you remember why all animals who have a long skull are called vertebrate animals?

"What are germs, and how can you kill them?

"Every kind of food that grows in the ground is called a vegetable. Is flour a vegetable?

"Why do men and boys that work hard require a good deal of food that makes fat, called 'body warmers'?

"Why is an egg that has been beaten or whipped a cooked egg?"

The greatest rainfall in twenty-four hours in the British Islands has been registered in the Isle of Skye.

According to Mrs. Mary Treat ("American Naturalist") the great crested flycatcher (*Myiarchus crinitus*), when building its nest in a box, fixed in a vineyard for the purpose, at first holds the sticks by the middle, and tries in vain to force them through the door. At last the bird learns to push in the sticks end first, and the nest is soon completed. Is not this a case of reasoning, a right conclusion being drawn from facts observed, and being then practically applied?

According to the "Tucson Citizen" a large and remarkable cavern, more than a mile in extent, has been discovered in the Santa Rita mountains, in Arizona.

The "American Naturalist writes—"No one is more solicitous for the protection of our wild animals than the true sportsman." This may be the case in America. In England he is utterly regardless of every creature not in the game-list.

M. V. Galtier submits to the Academy of Sciences the following startling conclusions:—The injection of the virus of rabies into the veins of sheep does not bring on the disease, but seems, on the contrary, to confer immunity. Rabies may be transmitted by inoculation, and by the introduction of the virus under any circumstances into the digestive passages of any animal. He even thinks that the injection of the virus into a vein may prevent the outbreak of hydrophobia *after* a bite from a rabid animal!

A writer in the "Boston Journal of Chemistry" seems to regret that a physician "is not required to write, talk, or in fact do any act which is fairly open to the world." We submit that

if there is one point in which the charlatan is invariably superior to the man of sterling ability, it is in the art of talking.

Dr. Lenz contends, from the presence of fresh-water fossils, that the Sahara is not the bottom of a sea which has been elevated.

In order to account for the mysterious disappearances of persons, now so common, a French writer suggests the existence of a disease not yet recognised, which, without any previous warning, suddenly resolves the patient into vapour. He even professes to have witnessed the disappearance of a friend with whom he was walking. A very simple consideration overturns this hypothesis. We can scarcely assume that the disease causes the sudden vaporisation of clothing, boots, keys, knives, money, trinkets, and all that the patient had about him at the time of his disappearance. Yet no one has ever found in the streets a complete suit of clothes from which the body of the wearer escaped!

At the recent meeting of the British Medical Association a resolution in favour of vivisection was passed with but one dissentient.

Dr. C. Jehn gives, in the "Chemiker Zeitung," a very striking case of fish perishing by thousands in consequence of water in which flax had been steeped having been allowed to flow into a stream.

M. H. Toussaint ("Comptes Rendus") finds that no contagious malady possesses a greater virulence than tuberculosis, the virus resisting and preserving its efficacy at temperatures which destroy the bacteria of splenic fever. The infection takes place as easily by ingestion as by inoculation.

ERRATUM.

Page 479, line 19 from bottom, *for* "animal" *read* "normal."